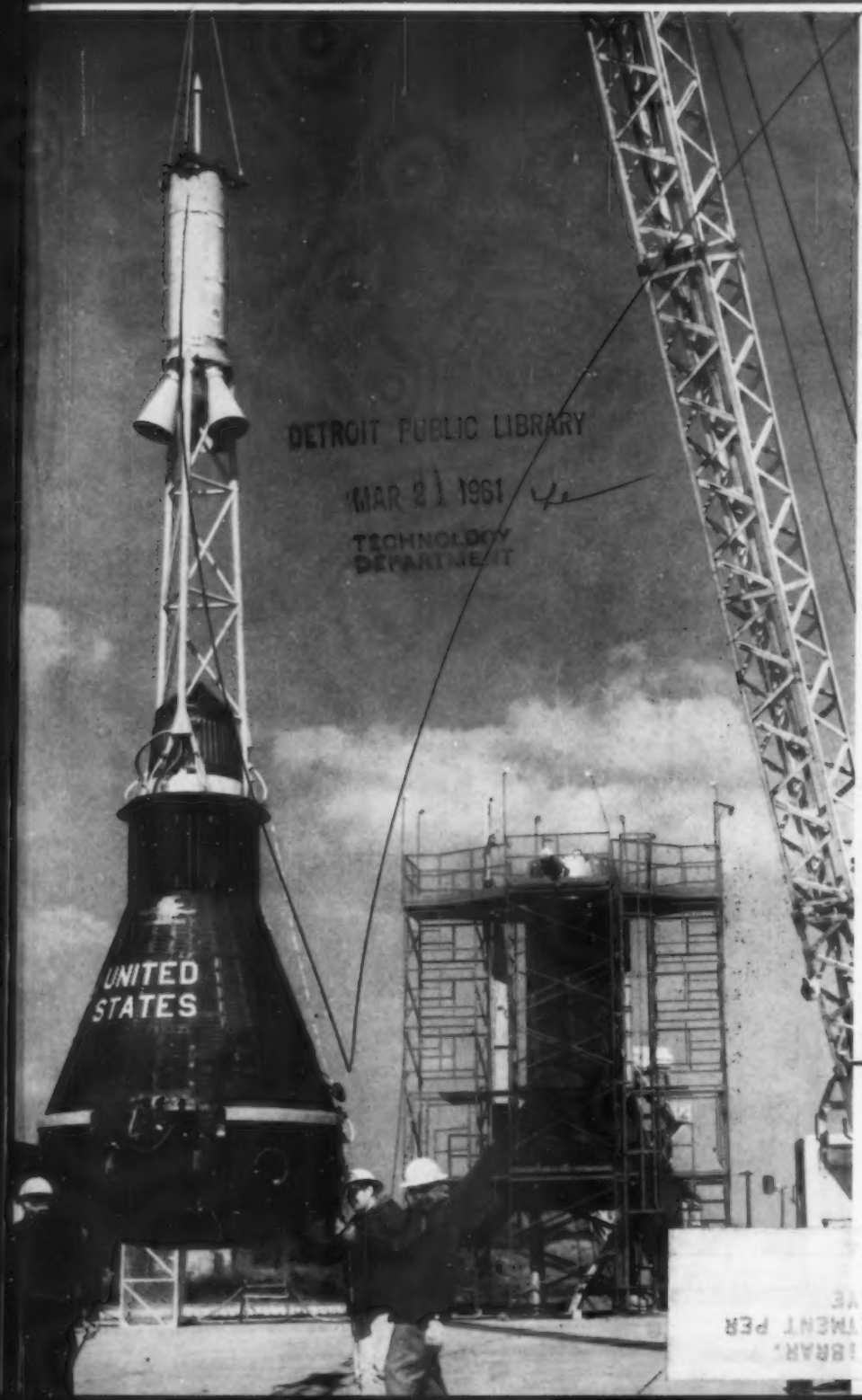
MARCH 20, 1961

# missiles and rockets

THE MISSILE/SPACE WEEKLY

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## Cost Bind Hurts Plan To Bolster Small War Forces

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AN AMERICAN AVIATION PUBLICATION

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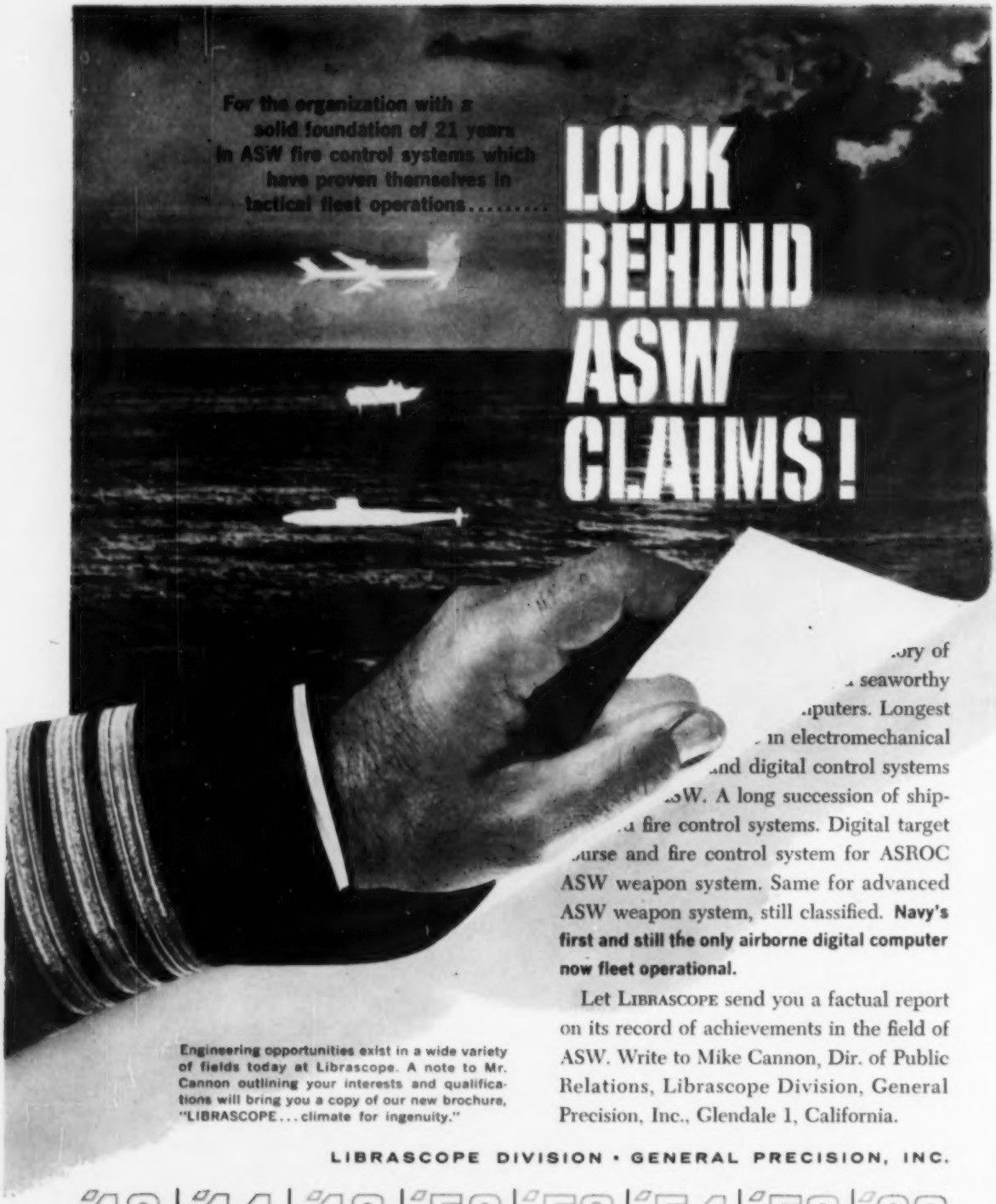
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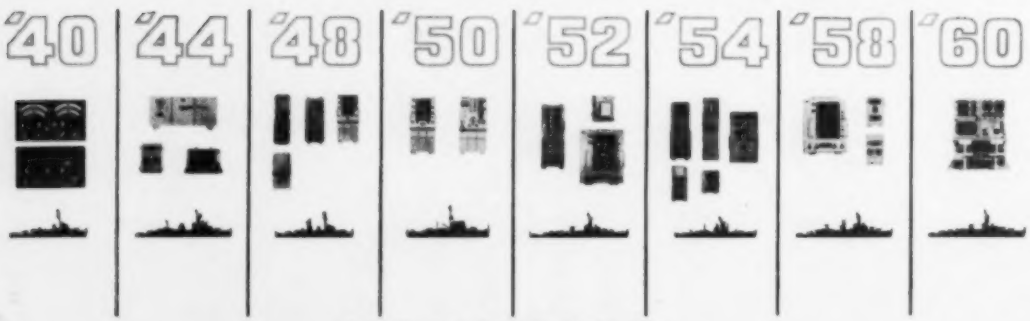


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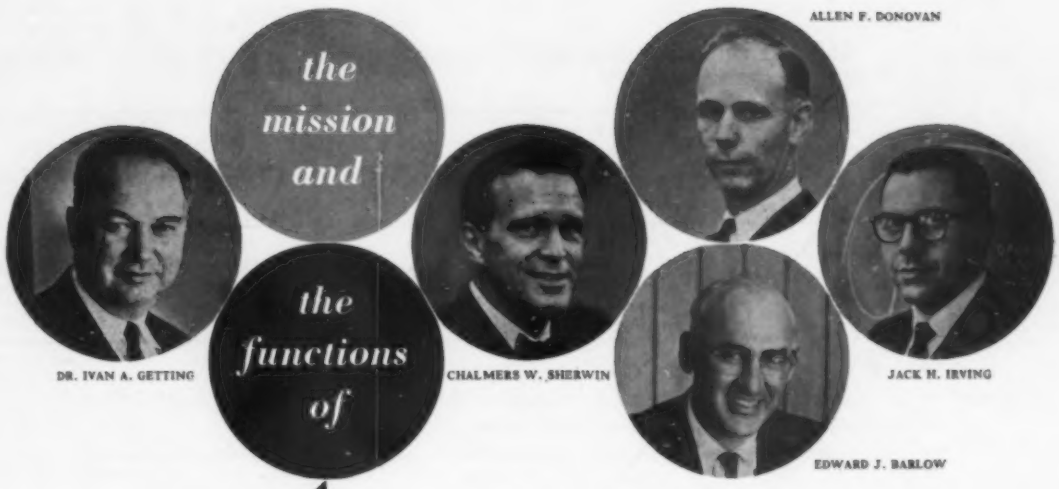


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THE MISSILE / SPACE WEEKLY

# missiles and rockets

Volume 8, Number 12 March 20, 1961

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## THE COVER

*Little Joe 6 stands ready for launching at Wallops Island, Va. Firing scheduled for last week was final qualification of capsule before manned flight. See p. 15.*

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*34,201 copies this issue*

**Opening Radiant "Windows" to the Universe** . . . Man's world has been compared to the inside of a dark room: his only view outside has been through a tiny window in the wall.

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*BUSINESSPAPER EDITORS Joseph Scheleen (Traffic World), Edward Lally (American Metal Market), William E. Howard (Missiles and Rockets), and Redington Fiske (Export Trade) address the New York Sales Executives Club.*

# *memo from the publisher*

THE FOUR MEN pictured above are editors from leading businesspapers in broad fields of American industry. They are half of a panel put together last month by Associated Business Publications, of which MISSILES AND ROCKETS is a member. The panel met at a luncheon of the influential New York Sales Executives Club to discuss important business changes expected during the next ten years.

MISSILES AND ROCKETS was asked by ABP to represent the missile/space market. We asked Managing Editor Bill Howard to boil down to a three-minute presentation everything that's liable to happen in the next ten years. Quite a task!

But separating the wheat from the chaff is nothing new to Bill Howard. As M/R's managing editor, in addition to directing the magazine's news and technical coverage, he's got to wade through mountains of staff-written and contributed copy, press releases and trade literature announcements to decide what items are important enough to be included in the current issue.

Bill Howard is well-qualified to sit behind the Managing Editor's desk, and you might want to learn more about the man who decidedly plays such a major role in what you're going to be reading every week.

Born in Albany, N.Y., Bill attended Dartmouth and Union Colleges and cut his journalistic teeth on European assignments for the *Stars and Stripes* during World War II. Since then he has undergone a honing process, first with a half dozen newspapers around the country and then for eight years with United Press International, that has turned him into one of the sharpest newsmen in the business.

You name it and he has probably written about it; from congressional hearings to hurricanes, from brinksmanship to capturing Brinks bandits, from white slavery to the White House. As a Washington newsman of long standing, he is an authority on matters political and the machinery of Federal government. By a rather strange twist of fate he covered the explosion and fire aboard the aircraft carrier Bennington in 1954, meeting the skipper, Admiral William F. Raborn—about whom he would later write a book under far different circumstances.

During his last few years at UPI, Bill discovered a new interest for his writing talents, the fast-moving developments in the science and technology of the missile/space field. We were fortunate in luring him away in February 1959 to become M/R's Ground Support Equipment editor; his broad understanding of the industry and outstanding reporting-in-depth prompted us to move him up to the Managing Editor's slot in May of 1960.

An author as well as an editor, Bill and M/R Military Affairs Editor Jim Baar have co-authored the successful book "Polaris!" for Harcourt Brace, and are currently working on another missile book to be published in the fall of 1961. Last week's issue of "This Week" magazine carried their by-line story on the first *Polaris* submarine peace patrol.

Howard lives in Chevy Chase, Md., with his wife, Helen, and three young sons, and steals enough time away from his editing and writing career to pursue his hobby of oil painting. He's one of the biggest reasons why we are able to say "If it's important in missiles and space, you'll read about it first in M/R."

Edward Mukefeld

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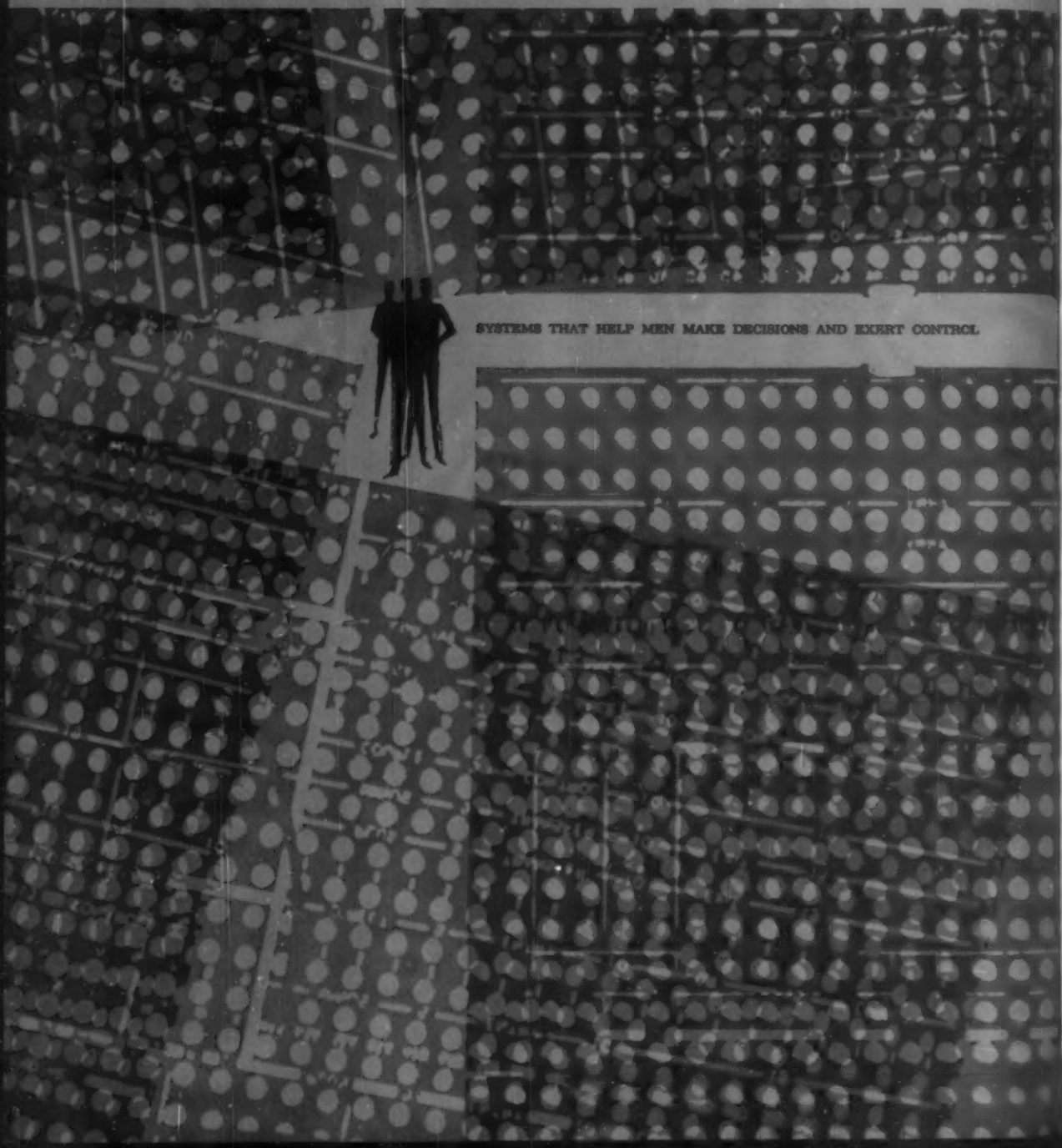

SYSTEMS THAT HELP MEN MAKE DECISIONS AND EXERT CONTROL

# The Countdown

## WASHINGTON

### Where's the Space Frontier?

Muttering grows louder on Capitol Hill over the continuing hold-up of the Kennedy Administration's promise to get the space program moving forward again. One of the big disappointments is the delay of the National Space Council, headed by Vice President Johnson, in getting organized. So-called "legal technicalities" restraining activities of the Council, COUNTDOWN is told, "could be corrected in about two minutes flat by Congress." Several influential men around Congress also are making it known that they are "quite disappointed" in the apparent lack of direction shown thus far by NASA Administrator James E. Webb.

### Communications Polar-Orbiter Shelved

The Army has dropped at least for the present work on development of *Steer*, a polar-orbitting communications satellite that was incorporated in the *Advent* program. *Steer* would have provided a satellite communications net in the polar regions that cannot be reached by the 24-hour GE-Bendix *Advent* system. However, *Steer* may be reinstated later.

### Dyna-Soar on the Brink

The ARDC push to greatly increase funding of the *Dyna-Soar* program is based on the argument that the present funding plan is a time-waster. As one informed official put it: "The program has reached the point where if we are going to do anything with it now is the time."

### Minuteman: Two for One

COUNTDOWN hears firmer and firmer reports that a second source for *Minuteman* is in the works in the Pentagon decision-mill. The two main reasons given are plans to increase the deployment rate and the Administration's search for anti-recession measures.

### Nike-Zeus vs. Enemy Satellites

The Western Electric *Nike-Zeus* as presently designed has long been considered capable of downing satellites, as well as missiles, with little modification. But the satellites would have to be within about a 200-mile orbit. Now, the Army discloses that with major modification *Zeus* could bat down satellites in 1200-mile orbits. However, the major modifications probably could not be completed before about 1967.

### Rocket-boosted Artillery

Army and Navy missilemen are taking an increasing interest in the development of rocket-boosted artillery shells with HE warheads. A number of engineers see in them at least one good possible answer to the growing need for a cheap HE-tipped missile. (See page 12.)

### B-70, ANP and the Knife

In searching for dollars in the defense budget, the Administration is reported looking ever more hungrily at the B-70 and ANP programs. The present (but still fluid) outlook: A deep slash in B-70 and continuation of ANP on a strictly R&D basis and along only one road.

## INDUSTRY

### JFK Blessing Small Business

The Kennedy Administration's search for means to spur on the U.S. economy and cut unemployment is increasing pressure on DOD to channel contracts to Small Business. The White House pressure also is directed toward passing the manna to depressed areas. This is not a matter of hopes and good wishes. This is what the marching orders are saying.

### Missileer Hopes Brighten

Some top Navy brass is hopeful of getting a go-ahead for the Missileer plane to carry the *Eagle* air-to-air missile. Latest feeling is that if funds are forthcoming they will be earmarked for Missileer, not for modifying an existing aircraft.

### Trainers for Astronauts

Air Force is looking over a North American Aviation proposal for two additional *X-15* rocket planes for use as two-place trainers for astronauts. Initial reaction to the idea is said to be favorable.

### R&D Intelligence

Thiokol Chemical Corp. is in pilot production of a new solid propellant with hydrocarbon polymers base that is said to have excellent elongation and low temperature characteristics . . . Component testing of NASA's Orbiting Astronomical Observatory will be done with *Aerobee 150-A* rockets equipped with an Aerojet-General 44.4-lb. attitude control system.

### Centaur Flight Slips

First launching of *Centaur* liquid oxygen-hydrogen rocket is slipping to "late 1961." NASA wants additional engine development to clear up conditions which led to two explosions recently on Pratt & Whitney test stands.

## INTERNATIONAL

### Spadeadam Still Lives

While the European Space Club debates the use of *Blue Streak* as a booster, Britain is keeping its Spadeadam Test Facility open at a cost of $850,000 per month. Total expenditure on the *Blue Streak*, developed at Spadeadam, is put at $240 million to date.

### Overseas Pipeline

A delegation from France will visit the U.S. soon to talk over development of satellite instrumentation to be launched by a NASA *Scout*. A similar group from Japan headed by Dr. Kankuro Kaneshige of the National Space Activities Council has just completed a tour of NASA facilities to see about its *Scout* project . . . Britain will spend $430 million to arm its V-bombers with *Skybolts* . . . *Skylark* high-altitude sounding rocket firings are under way at Woomera. Shot March 6 released a sodium vapor cloud at 100-120 miles.



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# The Missile/Space Week

## Dr. Brown for Dr. York

The man who will succeed Dr. Herbert York in the key post of Pentagon R&E Director is a physicist, an authority in nuclear reactor design and one of the youngest men to join the Kennedy Administration.

The 33-year-old new R&E chief, Dr. Harold Brown, is the director of Lawrence Radiation Laboratories. He is also a consultant of Aerojet-General, the Air Force Science Advisory Board and the President of the United States.

Dr. Brown is expected to take over his new job this spring. Dr. York, who was requested to stay with the new administration a few months, will take a post at the University of California.

## U.S. ICBM Force Now 18

Nine *Atlas* missiles in three complexes of the 565th. Strategic Missile Squadron went on operational status March 10—raising the Strategic Air Command's war-ready force of ICBM's to a total of 18. The 565th SMS is the second of three *Atlas* squadrons at Warren AFB, Cheyenne, Wyo.

## Aerie for Eagles

The Air Force is considering modifying KC-135 transport aircraft for use as *Eagle* air-to-air missile launchers.

The system under study by the North American Air Defense Command could operate autonomously or with other air defense units. Each plane could receive targets from its own sensors, other aircraft, surface radars or information centers such as SAGE.

*Eagle* is under development by Bendix for the Navy. The Boeing KC-135 jets, which would be called *Aerie* (eagle's nest), would carry more than two dozen missiles apiece.

## Navy orders 3000 Bullpups

The Navy has ordered approximately 3000 more *Bullpup* missiles from The Martin Co. at a cost of $14 million.

The price represents a 57.3% decrease per missile from prices when production began in 1958.

At the same time, a $1-million contract was awarded to Maxson Electronics Corp. of New York to second-source production of *Bullpup* guidance and control components.

## Big Booster Studies

North American Aviation, Convair Devision of General Dynamics and The Martin Co. will perform design studies of a liquid-propellant vehicle with booster thrust of 2-3 million lbs.

NASA's Marshall Space Flight Center last week awarded contracts of $163,040 to North American, $148,487 to Convair and $115,565 to Martin.

The vehicle would be based on the Rocketdyne *F-1* or possibly the LOX-hydrogen *J-2* in the booster stage. Upper stages would be nuclear or LOX-hydrogen.

**Rocket Sled Tests Navy Guidance**

*AEROJET-GENERAL'S supersonic rocket sled blasts off during recent tests of a guidance system at the U.S. Naval Ordnance Test Station, China Lake, Calif. Guidance is carried in nose section of sled in shot down the SNORT (Supersonic Naval Ordnance Research Track). Sled has total thrust of 84,000 lbs.*

## Orbital Launch for Rebound

NASA's Goddard Space Flight Center is asking for bids by March 31 on an 8-month design study of an orbital launching technique for Project *Rebound*.

The study calls for developing a method of launching 140-ft.-diameter passive communications satellites from a large orbiting satellite.

First launch in mid-1963 with an *Atlas Agena B* vehicle will be a spacecraft carrying three balloon satellites, each weighing between 400 and 1000 lbs.

Later in 1963, the plans call for launching 6 Balloons with a *Centaur* vehicle. The satellite may be in an elliptical orbit ranging from 1500 to 2500 miles, at an inclination of 45° to 90°. However, the balloons themselves must be in circular orbits perfectly spaced so that they will decay simultaneously.

Ultimate plans call for launching up to 12 *Echo*-type balloons from a single spacecraft.

## K: Watch the Russians

Russian Premier Nikita Khrushchev is "confident that the time is not too far off when the first (Soviet) spaceship with a man aboard will dash into outer space."

Khrushchev made the prediction following the second successful return of a Russian space vehicle containing animals. The Soviets said the vehicle, launched and returned March 9, landed at a preselected spot inside the Soviet Union. Two previous "Zooniks" were burned up in the atmosphere.

The ship contained a 14-lb. dog, guinea pigs, black mice and "other biological specimens." Moscow radio said the dog was "feeling fine."

The rocket booster apparently broke into two parts after ejecting the return capsule. Orbital data released by NASA on the fragments are: Theta 2, perigee 106, apogee 131 statute miles; Theta 3, perigee 107, apogee 118 miles. Both have an inclination, of 64.93°.

## EIA Wants Insurance Plan

Electronics Industries Assn. is pushing for Congressional action on a bill to provide Federal indemnification of missile/space components suppliers in case of damage to private property by missiles and space vehicles. Conceivably, the Government, prime contractor, and component manufacturer could all be held liable in such accidents. Small subcontractors are becoming concerned over possible risks involved which could ruin them financially. Legislation, first presented to the 85th Congress by DOD, has never gotten a hearing. EIA feels that considerable pressure from DOD will be required to get the bill introduced.

## Relay Bidding Starts

An advanced version of the Project *Relay* active repeater communications satellite will come up for industry competition this year.

The first *Relay* is an 85-lb. spacecraft to be launched with a *Delta* vehicle early in 1962 into an orbit ranging from 1500 to 2000 miles. The advanced version will provide for multiple launchings with an *Atlas-Agena B* vehicle into an orbit ranging from 5000 to 6000 miles.

The initial National Aeronautics and Space Administration program calls for two *Delta* and two *Atlas-Agena B* launchings.

## CEA Switching Name

California Eastern Aviation, active in missile tracking, impact detection and electronics devices, has asked its stockholders to approve a name change to Dynatronics Corp.

The company also announced a 5% stock dividend. Sales jumped from $90 million in 1959 to $125 million in 1960. Backlog was up more than 35% over the previous year end reaching over $25 million at Dec. 31.

Subsidiaries of Dynatronics Corp. are: Land-Air, Inc., Air Carrier Service Corp. and Aircar Engineering International Inc.

## Far Out for 30 Days

A second pair of Air Force jet pilots have embarked on a 30-day simulated space journey at the School of Aviation Medicine.

The subjects, Capt. Ramon A. Horinek, and 1st Lt. Eugene R. Carlson, will be maintained at an altitude of 18,000 ft. although they will breathe a greater concentration of oxygen. They will eat pre-cooked, dehydrated food and use recycled body water for drinking, cooking, and washing. ⁂

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# Limited War Cost Bind

## *Administration Plans Hit by Slowdown*

***Questions before Pentagon and White House: Can the cost-squeeze and ever increasing complexity of Missile Age weapons be reversed? If not, how big can limited war forces of Army, Air, Navy be built up? Military officials seek help from industry in reducing R&D, production and O&M expenditures.***

**by James Baar**

THE MISSILE AGE cost squeeze is putting a crimp in Administration and Army-Navy plans for a sizeable buildup of the nation's limited war forces.

The high pricetags on much of the increasingly complicated equipment needed for the buildup is resulting in a decrease, at least in the rate at which it will occur and possibly in its overall size.

Moreover, the cost squeeze is bringing renewed, fervent pleas by Army and Navy officials to industry to help find ways to reverse the trend toward complication and spiraling costs.

The problem seldom has been made clearer than this last week at a Defense Planning Forum held in Washington by the Electronics Industries Association.

Rear Adm. J. A. Jaap, director of Navy development programs, put the matter bluntly by citing the cost of modern aircraft. He said that "an average airplane that would have cost $750,000 less than five years ago would, in its modern version, cost roughly $1.75 million today."

"In naval aviation we are losing airplanes at the rate of about 1200 a year as a result of wearing out, obsolescence, crashes and the like," he said. "But at today's prices we can replace these planes at a rate only a little more than half as fast as we lose them."

He made clear that the Navy is facing precisely the same kind of problem in its successive generations of missile systems.

• **Costly maintenance**—"As most of you know, we have some equipments in our ships today that are marvels of technical wizardry," Jaap told the hundreds of industry officials who crowded the big hall in a downtown hotel. "They are a delight for the designer, the builder and the contractor to behold and even we in the Navy point them out as the fanciest things that ever got into production. But we find they have one very significant defect. It takes a terrific amount of effort to make them work."

Hence, the admiral said, not only are such modern weapons highly expensive—their maintenance is equally expensive or more so.

*PERSHING, Army's biggest nuclear punch, in new, operational-type configuration.*

Just the routine maintenance these items require is a challenge to the capabilities of a graduate engineer," he said. "It is a far greater challenge to the under-21-year-old youngsters who make up about two-thirds of our enlisted strength today."

Jaap said a major step toward reversing the cost and complexity trend would be for industry "to give really serious attention to carrying out the aims of . . . *Project Kiss*"—the invention of Rear Adm. Paul Stroop, chief of the Bureau of Naval Weapons.

"*Kiss* unscrambled means 'keep it simple, stupid' (or, 'sir,' as the case may be)."

• **Simplicity, please**—The same theme ran through papers presented to the forum by an industry panel.

Welko E. Gasich, Northrop director of advance systems, said a close support missile with a maximum range of 40 to 50 miles is needed. He said the missile probably would have a solid motor, and HE warhead and "should be as simple as possible for easy field operation and maintenance."

"For today's modern weapons the M&O cost account for between two-thirds and three-fourths of the total cost of a weapon system, and, hence, are not to be considered lightly," he said. "In recent years, M&O costs have climbed (so) that, for small nations, the operation of complex weapon Systems is virtually prohibitive."

John F. Greco, requirements planner for Hughes Aircraft, said the successors to *Sergeant* and *Pershing* in the late 1960's must have "less bulk, greater reliability and accuracy, reduced maintenance and less prefiring checkout time . . ."

• **Trim paperwork**—A. Atley Peterson, senior Washington representative of Sperry Rand, suggested that a first step toward cost reduction would be

elimination of "needless paper studies."

"I believe every scientific or technological consideration has been duplicated at least once," he said. "Let's stop high-pressure selling and prove some of our ideas. This high-pressure selling exists within the government as well as outside."

Peterson also suggested a sharp reduction in "paperwork for its own sake." He said that a recent military study showed that "documentation for FY '62 would approximate 15 to 35% of contract value."

Then Peterson touched on an extremely sensitive point.

"Looking back over the factors . . . for limited war, we see a desperate need for planning," he said. "Instead of single-service approaches, we need an integrated approach. This does not mean a single service but rather a re-examination of the roles and missions. This in turn cannot be done without planning at the top levels . . . to integrate the political and the military."

Brig. Gen. R. C. Richardson III, chief of the Air Force's Long Range Planning Group, dug deeper at the same point.

"There is an inter-relationship that exists today between the rapid changes produced by technology, the costs of the new weapon systems and the consistency in our requirements for these," he said. "Our commitments remain relatively fixed, or else increase, or else . . . costs for individual systems have been rising along with their effectiveness --though not at the same rate."

He said the result is that quantity of forces, commitments or military concepts have to be adjusted in order to prevent the cost from ultimately overtaking the Gross National Product.

Richardson made no suggestions for adjustments in military concepts. However, the implication of his remarks clearly called into question the possibility of meeting the Soviet Union or other Communist powers on the ground in large numbers with conventional or only a small number of tactical nuclear weapons—a possibility close to the heart of overall Army limited war planning.

Richardson also recalled that a French general, when asked why the West persisted in thinking of fighting wars with nuclear weapons, commented:

"The Russians have more boots than we have butts."

How much this line of thinking and the cost-squeeze would affect Administration plans for strengthening the nation's limited war forces remained to be seen in the coming weeks.

*(For a report on ARS, ASME meetings in Los Angeles, See page 41.)*

***Limited War Needs***

# Role of Electronics to Grow

**by Hal Gettings**

ELECTRONICS will play an increasing part in the plans of all military services for limited-war capability during the next decade.

Primary emphasis will be on better, smaller, cheaper, and more reliable communications and related command control equipment.

Secretary of the Army Elvis J. Stahr, Jr. told the Electronic Industries Association defense market planning forum that command control—including communications, avionics, and combat surveillance—presents "more and greater challenges" to the electronics industry. In communications, he said, "we have a desperate need for both combat and global communications . . . with greater traffic capacity, greater speed, greater reliability, and more versatile facilities.

Stahr pointed out the developing need for new electronic equipment for Army aircraft—navigation, communications, flight control, identification, instrumentation—and the requirement for smaller and simpler systems.

He cited the growing importance of combat surveillance equipment for reconnaissance and weather information. Such systems must include electronic data processing for rapid assimilation and presentation of the gather information.

• **$6 billion market**—John F. Greco, Hughes Aircraft Co., said that the Army could be expected to spend at least $100 million alone for electronics for deep-penetration surveillance aircraft within the next ten years. Developments in this area will be divided among target acquisition, enemy detection, terrain and nuclear surveillance, and information processing.

Greco estimated the Army electronics market will total some $6 billion over the next decade. Over half of this ($3.07 billion), he said, would go for command control systems. Missile electronics will get $2.2 billion, air mobility $350 million, and "non-mission oriented research" $150 million. Limited war spending will peak in the 1966-67 period, Greco said, and gradually taper off toward 1971.

Brig. Gen. John T. Snodgrass, also speaking for the Army, called for increased research efforts by the electronics industry. He, too, stressed the growing importance of communications, surveillance, and command control functions in limited war. He said the increasing use of tactical radio and the lack of usable frequency spectrum calls for some real advancements in spectrum-saving techniques.

Refinements on present SSB and time-division pulse modulation techniques offer some hope, he said, but more research would open other areas. He mentioned the possibility of small tactical troposcatter systems and the need for a simple method of providing battlefield security for voice circuits.

Surveillance systems, too, Snodgrass said, offer a challenging field for electronics. He cited surveillance radar, high-definition data links, data processing and display equipment, and infrared and photographic sensors as real needs in the immediate future.

Speaking for the Navy, Rear Admiral J. A. Jaap, director of development programs, said the Navy's principal needs are improved navigation and station-keeping devices, new power sources, and an improved capability for detecting and disposing of enemy mines and submarines.

Electronics, Jaap said, will play a leading role in improving Navy tools for limited warfare. Advanced detection devices, automatic data processing equipment, and secure, reliable communications equipment with greatly increased traffic capacity are primary needs. Also, he said, we need "as yet undreamed of" equipment in the fields of electronic countermeasures and counter-countermeasures, and other phases of electronic warfare.

Brig. Gen. R. C. Richardson, USAF, said that the air activities of limited war impose new requirements on electronic and communication systems. Principally, he said, is the need to process, on a global basis, operational information on which to base command decisions and quickly assess developments no matter where the conflict takes place and whatever its size.

Next in importance is the ability to extend control of air operations with long ranges and use of remote bases.

Also, Richardson said, there will be a need for mobile tactical control and warning systems to operate in areas with very little in the way of facilities, power, communications, etc. Such equipment must be light, mobile, efficient, and able to be tied in with other remote bases or control and command.

Welko E. Gasich, Northrop Corp., also stressed the importance of reconnaissance and intelligence data acquisition and processing equipment. He said that equipment to handle these vital functions must be developed as total systems or combination of systems. ⌗

*At Missile/Space Conference*

# Zeus Seen as Anti-Satellite Weapon

***Meeting hears reports from Army, Navy, AF missile & satellite officials; honors awarded at Goddard Dinner***

NIKE-ZEUS could have an anti-satellite capability with but "little" modification.

Brig. Gen. David C. Lewis, director of special weapons in Army R&D, told the national Missile/Space Conference last week that minor changes could extend *Zeus* capability to 200 miles and major changes could extend the vertical range to 1200 miles. He said the longer range could be achieved by 1967 without interfering with full-scale production of *Zeus*.

Lewis told the conference, sponsored by the National Rocket Club, that *Zeus* is on schedule with every indication it will continue to move ahead on the program laid down four years ago.

Several critical problems must be solved, however, before the *Advent* 24-hour communications satellite can come into operational use. Lewis listed them as attitude control in orbit, station keeping in orbit and long life. He said low orbits are also planned in the *Advent* program.

The Air Force timetable calls for a new family of boosters to come into use about 1966. Maj. Gen. O. J. Ritland did not say whether the new booster family will be liquid or solid. However, John H. Rubel, Defense Department R&E Office, commented that the Air Force has a growing interest in solids.

Ritland said the post-1965 Air Force timetable also calls for a ballistic missile defense from a satellite platform, with the capability of killing an ICBM immediately after launch.

A Navy spokesman reported that navigational accuracy possible with the *Transit* satellite is in the range of 200-500 yards—"a ship's length." Rear Adm. Thomas F. Connolly, assistant chief, Bureau of Naval weapons, estimated the cost of a *Transit* receiver at about $10,000.

Later, Dr. Frank T. McClure of the Johns Hopkins Applied Physics Laboratory, said civilian craft could get accuracy to within a mile with equipment costing only $5000.

Dr. Harry Wexler, chief researcher, U.S. Weather Bureau, reported the eventual full operational weather satellite system will comprise six polar-orbiting *Nimbus* satellites and three *Aeros* satellites in 24-hour orbit. He said the cost of *Tiros* pictures was 17 cents apiece, comparable with the cost of conventional weather observations.

The three-day Washington conference wound up with the fourth annual Dr. Robert H. Goddard Memorial Dinner and the dedication of NASA's Goddard Space Flight Center, in Greenbelt, Md. (see photo).

These honors were awarded at the Goddard Dinner:

–Edward R. Murrow, director, U.S. Information Agency, received the National Rocket Club Award, given by Washington Technological Associates.

–The *Discoverer* industry team of Bell Aerosystems Co., Douglas Aircraft Co., General Electric Co., Lockheed Aircraft Co. and Rocketdyne Division, North American Aviation, received the Nelson P. Jackson Aerospace Memorial Award, given by the NRC.

–William J. O'Sullivan Jr. of NASA, who developed the thin skin for the *Echo* balloon satellite, received the Astronautics Engineer Achievement Award, given by the NRC.

–Lockheed Aircraft Corp. received the Dr. Robert H. Goddard Memorial Trophy, given by MISSILES AND ROCKETS.

–Allen M. Lenchek, University of Maryland, received the Dr. Robert H. Goddard Memorial Scholarship Award, given by the NRC.

## Goddard Center Half Completed

*FOUR BUILDINGS of the eight eventually planned for NASA's Goddard Space Flight Center were open for inspection at dedication of the center last week. On a line in lower part of picture are No. 2, Research Projects Laboratory; No. 1, Space Projects Building; and No. 3, Central Flight Control and Range Operations Building. Above center is No. 4, boiler house building. Space is cleared at top right for construction of No. 5, Instrument Control and Installation Laboratory. Three more buildings are to be completed by 1962. Center is located at Greenbelt, Md. between Washington and Baltimore.*

# Manned Shot Awaits Extra Firing of Redstone

FIRST MANNED suborbital flight in the *Mercury* program is being held up for one more *Redstone* shot, possibly delaying a U.S. astronaut's first glimpse of space until May 1.

The *Redstone* carrying a dummy *Mercury* capsule may go in the next week or so. It will prove out several corrections in the booster which were made following the 130-mile overshoot of the chimpanzee-carrying *Mercury Redstone 2* on Jan. 31.

Timing of the manned *Redstone* flight, which had been expected in April, now will depend upon the success of the forthcoming dummy capsule shot and also *Little Joe 6*, which was scheduled to be fired this past week from Wallops Island, Va.

Dr. Robert C. Seamans, associate NASA administrator, told M/R a series of difficulties developed with the *Redstone* in the *MR-2*. He listed them as:

–Failure of engine thrust regulator.

–Excessive vibration in missile vanes.

–Capsule-booster dynamic instability.

–Electronic wiring design inadequacies.

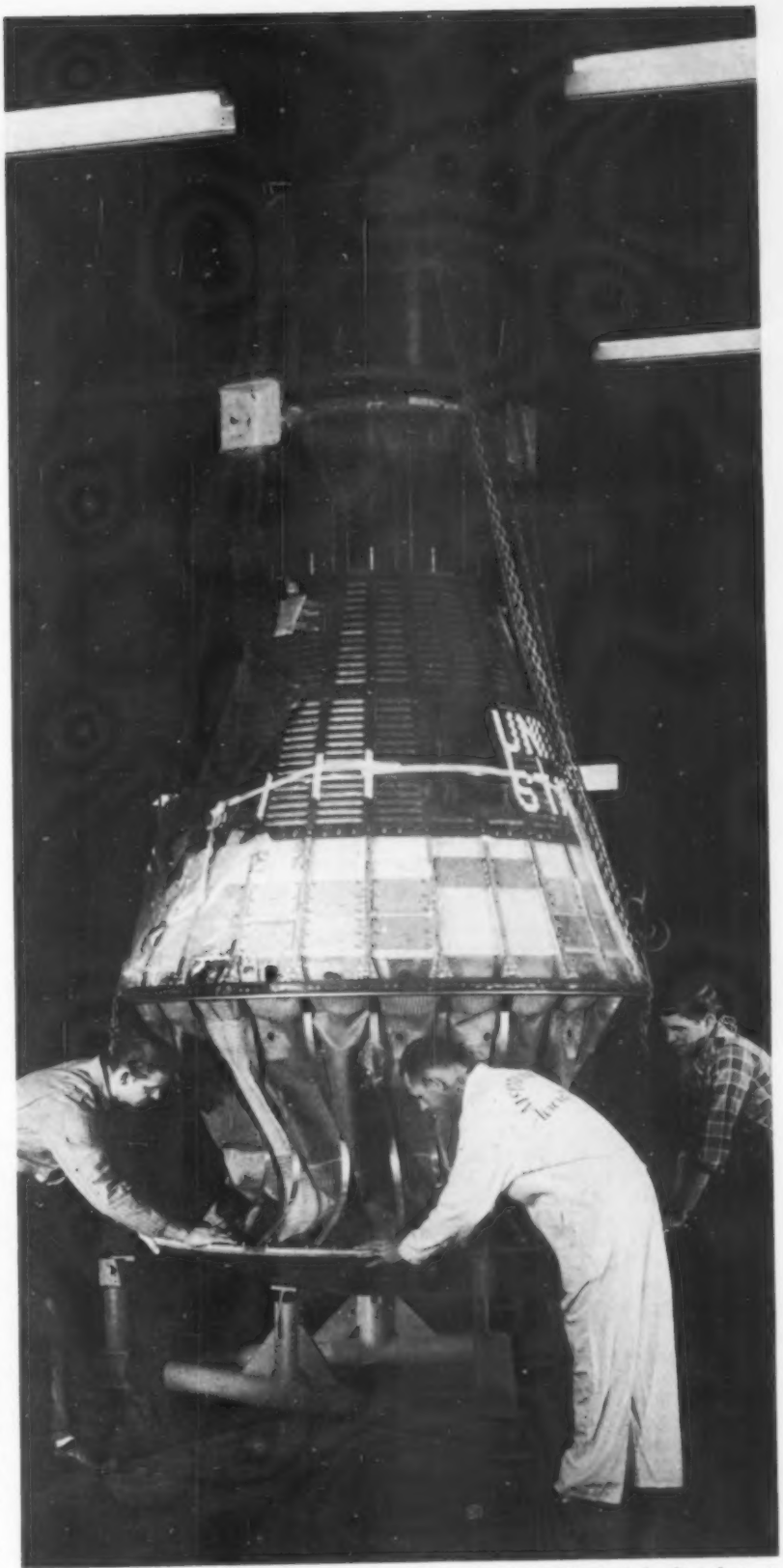
NASA decided to use a dummy capsule, Seamans explained, because it felt there was no further need to test the fully equipped and expensive capsule. Also, no attempt will be made to recover the boilerplate capsule.

The test will be designated *MR-BD (Mercury Redstone-Booster Development)*. The first manned capsule will retain the designation *MR-3*.

Seamans said the additional *Redstone* shot will undoubtedly cause some delay in the manned launching. But he said the delay will not be great if the *Redstone* development shot is successful.

Meanwhile, NASA's Space Task Group went ahead with plans for *Little Joe 6*, which was to be the final qualifi-

*(Continued on Page 36)*



*NASA'S LITTLE JOE 6 spacecraft will include a 4-ft. rubberized landing bag, to open after parachute breaks out and serve as air cushion for landing.*

## *UTC gets funds . . . .*

# NASA Begins Push for Big Solid-Fue

by Jay Holmes

***Ostrander hopes for an extra $15 million to be spent in FY '62; Webb starts review of budget; new program is possible***

THE BOSS OF launch vehicles in the National Aeronautics and Space Administration is publicly supporting solid propulsion for big boosters.

Maj. Gen. Don R. Ostrander told the House Space Committee last week he hopes $15 million will be added to the Fiscal Year 1962 budget to get going on the big solid. Recalling that President Kennedy asked NASA Administrator James E. Webb to make a thorough review of the U.S. space program, Ostrander said he had urged Webb to take another look at the possibility of increasing spending on solids.

Late last week, Webb and Deputy Administrator Hugh L. Dryden began what Webb described as a "systematic and somewhat formal review program," hearing proposals on revision of the previous administration's budget from directors of major offices within NASA. After completion of the formal review, Webb told the House committee, he expects to submit his findings promptly to President Kennedy. He said he already has decided he will recommend some budget changes.

Wernher von Braun, director of NASA's Marshall Space Flight Center, told the committee the Kennedy administration will seek increased funding for *Saturn* and *Centaur*. Ostrander explained that the *Saturn* money would go mainly for the *C-2* version of *Saturn*. The three-stage *Saturn C-1* is already funded, so that it could not be speeded significantly, he explained.

Ostrander said he also hopes to increase spending on liquid propulsion by $15 million in FY '62. Presumably, most of that would go to speed development of the Rocketdyne *F-1*, single-chamber LOX-kerosene engine with 1½ million lbs. thrust.

• **Specifics deferred**—Neither Ostrander nor Von Braun told the committee just how much additional money they sought. However, there are reports that requests for more than $140 million in the launch vehicle offices are pending before Webb and Dryden. Other NASA offices are also seeking increases, but those amounts have not been disclosed.

Ostrander told the committee NASA is funding United Technology Corp. to go ahead with the development of a 70,000-lb. solid segment for test firing by June or July. It was understood that the money still available in FY '61, will not pay the total NASA cost. Some of the payment will be FY '62 funds, available after July 1. The total amount of the contract was not disclosed, since it is still in negotiation. However, it will provide for sharing of costs between UTC and NASA.

The current NASA plan calls for following up the single UTC segment firing with the development of a two-segment test motor generating about 500,000 lbs. However, if President Kennedy and Congress approve Ostrander's request for an additional $15 million appropriation in solids, a separate program will begin for the development of a segment in the 100,000-110,000-lb. weight class.

In such a case, NASA would go out to industry for bids on the separate program. The initial contract would call for development of the single segment over the course of FY '62. However, the big segment development might well lead into a five-segment motor of total impulse comparable to the 1½-million-lb.-thrust *F-1*.

The single segment would develop upwards of 400,000 lbs. thrust for 60-70 seconds. A rocket made up of five such segments would develop something over 2 million lbs. thrust for the same duration—approximately comparable to the work load envisioned for the *F-1*.

• **"Difference of semantics"**—Ostrander told the committee the major advantage of a solid booster is that the unit cost will be lower than for a comparable liquid rocket. However, Von Braun cautioned that there are no short-cuts in the process of developing a reliable rocket.

Rep. Overton Brooks (D-La.), committee chairman, asked the Huntsville chief about a statement by Thiokol Chemical Corp. that a solid rocket of 2-3 million lbs. thrust can be developed in 18 months.

"There is a difference of semantics," Von Braun replied. "No doubt, they could build a rocket in 18 months. But when we look at the painful process of getting any rocket in a condition of operational readiness, we know that the time involved is longer."

Brooks asked whether Von Braun thought the claim too optimistic.

"Yes, sir," Von Braun replied. "We have to go through a painful process of checking, to make rockets more reliable."

• **Much interest, little money**—At this point, Ostrander interjected, "We in NASA are extremely interested in the large solid-propellant rockets."

The launch vehicles director was asked why there is such a great disproportion between NASA's projected spending for liquid and solid propul-

### *Box Score, U.S. Orbital and Earth Escape Launches*

| Vehicle | Launch Attempts | Successful Launches | Batting Average |
|---|---|---|---|
| VANGUARD | 11 | 3 | .273 |
| JUPITER-C | 6 | 3 | .500 |
| THOR-ABLE | 7 | 3* | .429 |
| JUNO II | 8 | 4* | .500 |
| ATLAS | 1 | 1 | 1.000 |
| THOR-AGENA A | 15 | 10 | .667 |
| ATLAS-ABLE | 3 | 0 | .000 |
| THOR-ABLESTAR | 6 | 4 | .600 |
| ATLAS-AGENA A | 4 | 2 | .500 |
| THOR-DELTA | 3 | 2 | .667 |
| SCOUT | 2 | 1 | .500 |
| THOR-AGENA B | 6 | 5 | .867 |
| TOTALS | 72 | 38 | .528 |

** Pioneer I and Pioneer III rated as successful, although they failed to reach escape velocity, because both rose to altitudes of more than 60,000 miles.*

Box compiled by M/R

# ...ueBoosters

sion in FY '62. The Eisenhower budget calls for $68.7 million in liquid propulsion and $3.1 million in solid propulsion.

"We have inherited a number of launch vehicles from the military," Ostrander replied. "Also, the military is doing work on solids that we don't want to duplicate. But in view of its rapid advances, I believe we will want to increase our solid propulsion budget and I will ask Mr. Webb to take this into consideration."

Von Braun told the committee:

"You gentlemen can rest assured that whenever large solid or nuclear propulsion systems reach the state of maturity to become really competitive in this race for an economical space transportation system, we shall certainly take advantage of them."

• **Other voices**—Ostrander and Von Braun appeared before the House committee at the conclusion of a week of hearings on the nation's booster program. Industry spokesmen made these points in earlier hearings:

Samuel K. Hoffman, president, Rocketdyne Division, North American Aviation—Performance of solid-propellant systems is not sufficient to accomplish space boost missions as effectively as liquid or nuclear systems, which he said are a natural outgrowth of liquid propulsion. He recommended acceleration of the *F-1* engine, which he said is operating on a five-day week, with less than 2% overtime. He urged concurrent development of a vehicle around the *F-1*.

–Dan Kimball, president, Aerojet-General Corp.—A large segmented solid rocket could be developed in two to three years. He also urged increased work on large, efficient pump and pressure-fed liquid rockets, development of nuclear rocket technology for space, augmenting of work on booster recovery schemes to allow repeated use of large liquid boosters and continuous high-level support of R&D to advance propulsion technology.

–Dr. Harold W. Ritchey, vice president, Thiokol Chemical Corp.—His company can produce and deliver within 18 months a solid booster capable of generating 3 million lbs. thrust at costs comparable with liquid-propellant rockets. Some NASA officials are interested in his plan but there has been no official go-ahead. A cluster of seven such units, in combination with selected nuclear and electric propulsion stages, could allow cargo and transport flights to all parts of the solar system in the 1970 time period.

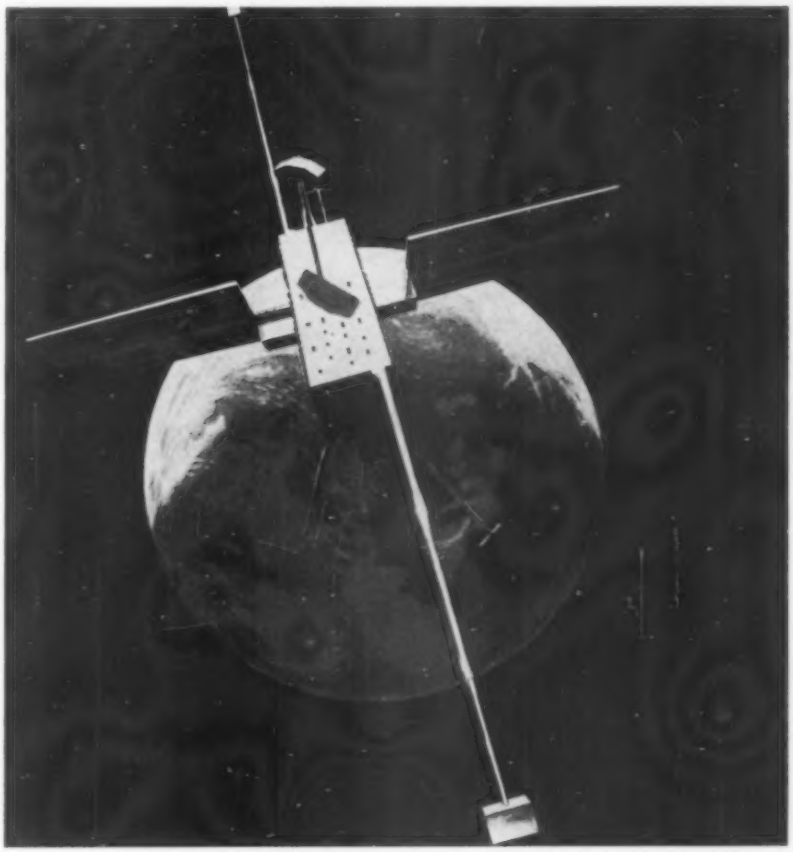
–Dr. Barnet R. Adelman, vice president-general manager, United Technology Corp., a United Aircraft subsidiary—His company is developing with its own funds a family of low-cost solid boosters that will permit the firing of the world's largest flight-weight solid rocket in the fall of 1961—with thrust of 500,000 lbs. for 60 seconds. Adelman apparently referred to the combination of two 70,000-lb.-weight segments under the cost-sharing arrangement with NASA mentioned above. He said the program could lead to an engine of 2 million lbs. thrust by 1964.

–William B. Bergen, president, The Martin Co.—Concentrate first on the liquid booster for large first stages. Apply any money left over to the solid booster. If the military is ever to have a more useful weapon than the ICBM, it will require new boosters. There should be a single U.S. booster technology, but differing civilian and military objectives will result in requirements for differing boosters for the two departments.

–J. R. Dempsey, manager, Convair Astronautics—The Air Force will require a workhorse booster of 800,000 to 1 million lbs. thrust, with special attention paid to low cost and simplicity. He urged a timetable for booster capability "plateaus" as follows: 20,000-30,000 lbs. in orbit in the next few years; 200,000-250,000 lbs. in orbit in 7 to 12 years; lunar base capability thereafter. ⌗

*The cigarette lighter and the match illustrate the difference between liquid and solid propellants, Dr. Wernher von Braun told the House Space Committee last week.*

*Von Braun said the example shows there is a need for both kinds of propulsion, depending on specific mission requirements.*



**Orbiting Geophysical Observatory**

*NEWLY RELEASED conception by Space Technology Laboratories artist of NASA's Orbiting Geophysical Observatory (OGO)—the so-called "streetcar satellite" for which STL is prime. The first 1000-lb. OGO is scheduled to fly in 1963.*

*By Siddeley, SEREB . . .*

# Joint U.K.-French Effort Proposed

***Plan costing $150 million would include nuclear defense against satellite attack; official blessing apparent***

**by Bernard Poirier**

TWO OF THE MOST powerful combines in the European missile/space industry have offered a five-year, $150 million package to the British and French governments.

Involved are proposals on nuclear payloads, large rocket vehicle requirements and earth satellites—each to have Anglo-French designs. The military proposal again pinpoints NATO's modern ailment—the whole not having the military capability of its parts.

Britain's Hawker Siddeley Group and France's IRBM Agency, SEREB, conducted a joint study for several months before making these formal proposals backed by a 150-page Aerospace Report.

The two governments are asked to join in a $150-million effort which precludes U.S. participation but leaves the door open to other European nations who are willing to pay their way. The British share reportedly will be 51%, France 49%, unless others participate.

While the official announcement alluded only briefly to modern NATO requirements, informed M/R sources in Europe said the military anti-orbital-missile project could involve 1700-lbs. nuclear payloads designed to destroy enemy "nuclear rain" satellites by proximity detonation in the silence of outer space.

If Britain and France agree to this project, the latter will enjoy a political breakthrough in the Big Three Nuclear Club barrier, although most experts consider France a self-evident member of a Big Four Nuclear Club.

Other proposals, with less political impact, call for Civil Communications Satellites, *"Transit"* Navigation Satellites, propulsion, materials, lightweight structural research and electronic miniaturization development.

• **Homemade deterrence**—The companies attached much importance to the proposals "in these times of economic competition." However, one informed source described the feeling that France and England must get into space soon, on their own, or pay the premium later for the right to share in American know-how.

The Hawker Siddeley/SEREB study, believed to have started during the Eisenhower Administration, echoes widespread opinion that Western Europe should develop missile/space deterrence on its own. France is already committed to a multibillion-dollar strike force (M/R, Feb. 6, p. 40).

Moreover, several recent British proposals for European space cooperation could not have made any headway without a semblance of official blessing, which, at the very least, was not withheld.

The two industrial giants said "The anti-satellite project illustrates current trends in military thinking and it may become of great significance in future NATO defense plans."

The British group controls seven aviation and missile companies, the largest single group in the Commonwealth. The government controlled SEREB Agency, Société pour l'Etude et la Réalisation d'Engins Ballistiques, is the ballistic weapon system manager. Its shares are held by Nord, Sud, SNECMA, ONERA, G.A.M. Dassault, MATRA and SEPR.

Their reference to NATO plans is, at very best, a diplomatic understatement. The problem of anti-satellite defense is at least four years current and was described in 1958 by U.S. Lt. Gen. J. M. Gavin and by Russian Maj. Gen. G. I. Pokrovskii.

Also, the recent Soviet Venus probe (M/R, Feb. 20, p. 13) prompted immediate Congressional testimony describing the threat of military satellites as more imminent as the result of this Russian experiment.

Politics, like education, has had difficulty keeping pace with space evolutions. America's largest allies in NATO have become particularly impatient in the last year for some integrated NATO projects in this area.

Absence of political agreement has prompted these allies to consider several mutually beneficial projects, such as the recent Strasbourg Satellite Booster project (M/R, Feb. 20, p. 36).

Many British and French strategists feel Western Europe must have a nuclear/space capability. This can be obtained within or without NATO. The requirement, they feel, is necessary despite the costs involved.

• **Avoid "re-invention"**—It is precisely this problem of developing such European capabilities outside NATO which caused Paul-Henri Spaak, former NATO Secretary General, to declare last December: "The West is wasting its wealth . . . when . . . Allies are spending tens of thousands of millions merely to re-invent things which already exist."

His assertion would not have condemned a project such as the Hawker Siddeley/SEREB proposal but would have asserted that the Western Alliance was remiss for not having responsive political capacity to provide modern military requirements needed in the 1960's which had not been foreseen at the time the Treaty was drawn.

In the absence of any NATO agreement fulfilling needs outlined by Gen. Norstad in Rome and in Paris, the U.S. may see many opportunities to have a voice in international space/nuclear deterrence projects slip between its fingers.

Both Hawker Siddeley and SEREB recognize some European limitations for programs as have been or will be attained by the U.S. However, they feel there has been enough delay on two counts: determining which space and military projects are attainable with European resources and building up the state-of-art before the U.S. space effort gives American industry too great an advantage over European industry.

Sir Roy Dobson, Managing Director of Hawker Siddeley Group, said, "From an industrial point of view we feel that initially an evaluation must be made of projects within the scope of Western European capability."

It was further revealed that the Anglo-French industrial study was conducted in order to evaluate the space potential of Western Europe. Membership may be open to other Western Europeans but several pointed references were made to the European character which will prevail in any final organizational structure. ■

## men at work on a new approach to the stars

As principal instrumentation contractor for Project Rover, EG&G is already at grips with the central problems of nuclear propulsion for deep outer space exploration. A control, instrumentation and data acquisition system designed and operated by EG&G is of basic importance in the full-scale testing of Rover's KIWI prototype engines, designed by the Los Alamos Scientific Laboratory. The EG&G system is being effectively applied to the solution of problems of heat transfer, neutronics, fluid dynamics and general control.

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**Said Johann Kepler:** *"The planets move in elliptical orbits about the sun, and the square of their periods of revolution are proportional to the cube of their mean distances from the sun."*

With interplanetary voyages fast becoming a reality, complete information regarding the velocity requirements for travel between planets is of vital importance. With these data available, it is possible to analyze propulsion requirements, plan ultimate system configurations, and conduct feasibility studies for any particular mission.

Lockheed Missiles and Space Division scientists have actually evolved a rapid-calculation method, utilizing a high-speed computer. This has produced literally thousands of orbits, velocity requirements, and elapsed time, for design studies of trips to and from both Mars and Venus—every tenth day from now until January, 1970.

More simple to analyze are many factors which make Lockheed Missiles and Space Division a wonderful place to live and work. Located in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, Lockheed is Systems Manager for such programs as the DISCOVERER and MIDAS satellites and the POLARIS FBM. These, together with research and development projects in all disciplines, make possible a wide diversity of positions for creative engineers and scientists in their chosen fields.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-14A, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required.

**Lockheed** / **MISSILES AND SPACE DIVISION**

*Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS Programs*

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII

# Technical Countdown

## ELECTRONICS

### 10-Year Guidance Trends

As inertial guidance system characteristics change during the next decade or two, cost and production trends will change significantly, according to industry estimates. In moderate production, typical unit costs will drop from present $400,000 to $100,000, and development time is expected to be reduced from six to two years. During this same period system weight should drop from 300 to 50 lbs., cold-start response time decrease to 5 minutes, and reliability increase to 3000 hours MTF.

### New Scatter Circuits Operational Soon

Tropospheric-scatter telecommunications continue to burgeon. First BMEWS telephone circuits, using this propagation mode, are now being tested by the Air Force between Clear and Fairbanks, Alaska. These employ the first four of 34 stations using microwave and troposcatter which Western Electric is installing in the Alaskan region. The Clear system is due to become fully operational this summer. Other circuits will augment White Alice Communications System for NORAD.

### Existing Scatter Circuits to be Expanded

Pioneer in the scatter field, Page Communications Engineers, recently received a channel-expansion contract from the Navy to double its Iceland Troposcatter system capacity, and another from the Air Force to study means of increasing channel capacity on its North Atlantic Ionoscatter system. Proof of performance on AF program results will be demonstrated over an experimental circuit between Stoney Pt., N.Y. and Carrabelle, Fla.

### Big Scatter Dish Mobilized

A 30-ft. mobile troposcatter dish antenna has been developed by Antenna Systems, Inc. The self-contained assembly is carried in a flat-bed trailer. Mesh or solid paraboloidal surfaces are available, its developers say, and unit can be operated under normal wind loading without guys.

## OPTICS

### CCTV Amplifiers Cited for Astronomy

Closed-circuit television-type optical amplifiers offer better detectivity for astronomical purposes than conventional photographic systems or image converters. These findings were reported recently by Aeronautical Research Lab of the AF's WADD, following its investigation to find equipment limits for detecting very faint stars in the presence of the sky background.

### Ten-Magnitude Increase for Star Detection

The theoretical possibility that 34th-magnitude stars can be photographed using an intensifier image orthicon for nighttime observations is advanced in a current report by AF Research Division, WADD. This would be a 10-magnitude increase, since the faintest celestial body ever recorded with an image device was a 24th-magnitude star obtained with the Mt. Palomar 200-in. reflector. Key to such an increase, the Air Force says, is use of a storage target plate with capacity to hold and integrate charge image for at least 80 minutes with negligible loss of resolution or charge.

## ADVANCED MATERIALS

### U.S., Russia on Free Radical Par

The Russians have not made any significant advances in free radical chemistry beyond our own efforts in the field. A Government survey concludes that the Soviets are either not interested in free radical stabilization, or they are so interested they are keeping it a secret.

### Boeing Casts Titanium Alloys

A commercially feasible process for the production of titanium alloy castings using rammed and machined graphite molds has been developed by Boeing for the Air Force's Air Materiel Command. A procurement specification, quality control procedures, inspection standards and design criteria were also established.

### Navy Perfects Glass Tensile Tester

A hydraulic ring tensile tester which ruptures reinforced glass hoops is being used to develop a much-needed collection of quality control data. The information is often directly applicable to the design of large motor chambers. The instrument was developed at the Naval Ordnance Laboratory, White Oak, Md.

## SUPPORT EQUIPMENT

### Another Checkout Contender

Lockheed's Georgia Division at Marietta is moving into the GSE business with a contract for about $350,000 worth of checkout equipment for *Saturn*, under a contract with NASA's Marshall Space Flight Center.

### Tape-fed Machine Produces Atlas Parts

*Atlas* missile parts are being turned out automatically at Convair by a "machining center" which receives instructions on punched tape. The device is a Kearney and Trecker Milwaukee-Matic Model 2, which selects 31 tools in any sequence from a storage magazine.

## PROPULSION

### Polaris Not For Shore Use?

*Polaris* can't be adapted to Army use because it can't withstand the shock and wide temperature ranges involved, says Dr. Wernher von Braun. He said the Navy gave priority to high $I_{sp}$ rather than shock and temperature resistance in *Polaris*, because requirements are easier aboard nuclear submarines, where there is plenty of power available to air-condition the missiles.

## ASW ENGINEERING

### 300-Ton Hydrofoil Award Due Soon

Proposals for the AGEH (Hydrofoil Research Ship) will be due into the Navy's Bureau of Ships early in April. Invitations to bid for the 250-to-300-ton-displacement vessel went out the first week in January. If Congress approves the concept, the award will be made this summer.

### 15-Ton Hydrofoil RFQ's Next

Another BuShips bid request will go out early this spring for a supercavitating R&D hydrofoil of about 15 tons displacement. The ship will be used as a test bed for power transmission systems and possibly for boundary layer control of the propeller.

America's FIRST man into space will rely on a Honeywell designed and developed Attitude Stabilization and Control System for controlling his space capsule. This system automatically damps out initial launch rates, orients and maintains the capsule in proper orbital plane, and provides for the correct descent trajectory and re-entry angle. This device is just one of the many contributions being made by Honeywell scientists and engineers to our nation's space programs.

**Honeywell**

Military Products Group

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Increased activity in the design and development of advanced stabilization and reference systems has created these select, high-level professional openings in the Aero Division of the Honeywell Military Products Group.

**Senior Development Engineer**—3 to 5 years' experience in Electro-Optical Development Design of unique optical pick-offs and their application to advanced inertial instruments.

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**Gimbal Servo Design Engineers**—Experience in design and development of platform type servos with gearless torque motors; familiar with transistor circuitry.

**Senior Development Engineer for Gimbal Transmitters**—Experienced in servo-design high-accuracy repeater systems, with specific experience on precision resolvers and inductosyns.

**Senior Systems Development Engineer**—Experience in electronic systems and sub-systems. Capable of translating requirements into block diagrams and block diagrams into circuits.

**Senior Mechanical Development Engineer**—Experienced in electro-mechanical design with gyro or platform design and analysis.

Send your résumé stating your areas of interest, or request for further information to: Mr. Clyde W. Hansen, Technical Director, Aeronautical Division, 2622 Ridgway Road, Minneapolis 40, Minnesota.

*To explore professional opportunities in other Honeywell operations, coast to coast, send your application in confidence to: Mr. H. D. Eckstrom, Honeywell, Minneapolis 8, Minnesota.*



Circle No. 5 on Subscriber Service Card.

# Air Seals: Missilemen's Key to Life

***How unique blast closure valves with response time of 2/5 second were developed to protect sites from nuclear attack***

**by William Beller**

THREAT OF SURPRISE nuclear attacks is driving the allowable response time of some ground support equipment below one second, for hardened ICBM sites.

The most critical GSE components from the viewpoint of the launch personnel—parts whose rate of response could determine whether the personnel survive the attack or die—are the seal mechanisms through which ventilating air passes. These are the mechanical seals in the ducts that lead from above ground to the major compartments of the missile facility: the silo crib which holds the missile, the underground launch control center, and the entry tunnel which runs between them.

The seals have a simple purpose: to close quickly when an attack is pending; to open when the danger is over.

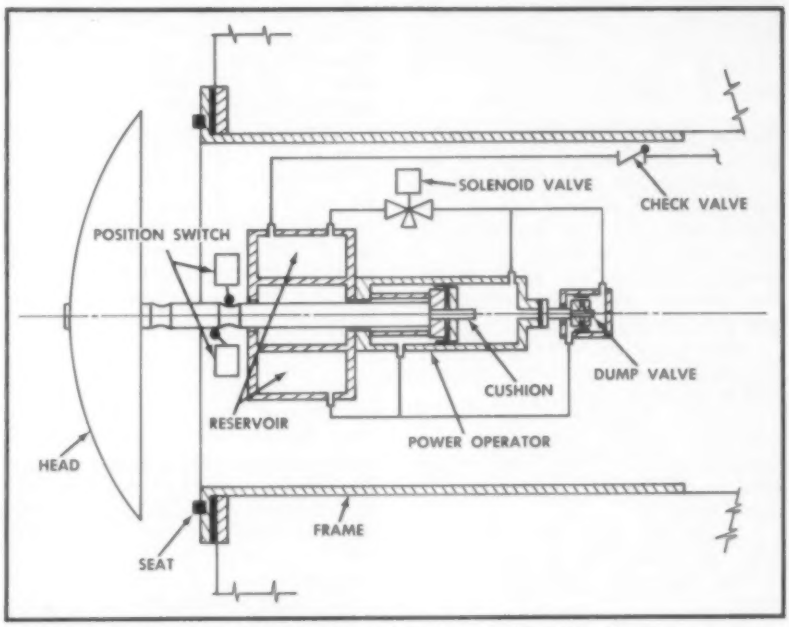
There are eight such seals. Their response times are one-fifth of a second or better. The two larger seals are 3½-ft. in diameter. They are all stressed to 200 psi overpressure, sufficient to resist a 10-megaton nuclear bomb exploding one mile away.

• **A unique design**—When studies first started on the design of these blast closure valves, there were no applicable engineering data. Of course, designers had had experience with relatively small, slow-acting valves, but not with the fast-acting, large ones needed now. As a result, basic design criteria were set up early in the development program.

These called for blast closures capable of (1) closing rapidly, and positively, (2) resisting anticipated blast and shock effects, (3) maintaining a positive seal during closure, and (4) operating reliably under rigorous environments and infrequent cycling.

The designers decided that a pneumatically-powered mechanical system would be the most reliable. They also agreed that the closure door should be on the same shaft as the power operator or piston.

Since a piston was to be used, and since it had to be fast-acting, the static




*BLAST CLOSURE SCHEMATIC shows how dump valve pilots the power operator.*

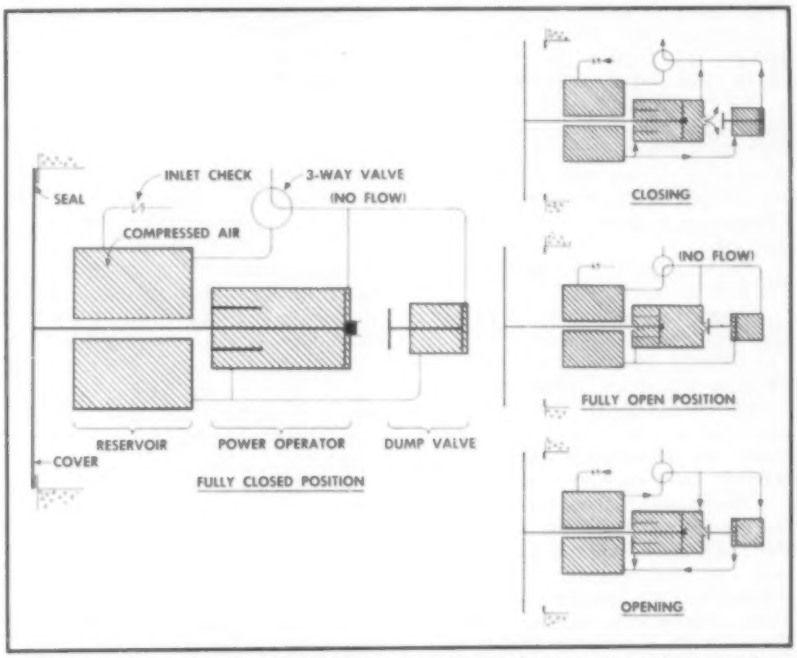
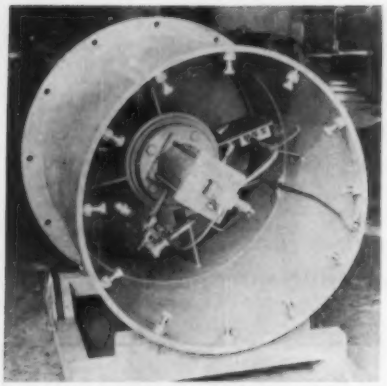



*DIAGRAM TRACES COMPRESSED air flow during closing and opening operations.*



*CLOSURE MECHANISM for seal shows dump valve atop tower operator.*

friction problem eliminated many of the materials commonly used for seals and packing. Yet, some of the fluorocarbons did show some promise; and Teflon was tried. The engineers now report that this material has for all practical purposes "eliminated the friction problem within the temperature and pressure limits of the design."

Here is how the blast closure works, starting from the normally open position to the fully closed one:

1) The solenoid valve is de-energized, thereby disconnecting the compressed-air reservoir from the blank ends of the power operator and the dump valve.

2) At the same time, the blank ends are connected to the exhaust through the newly positioned solenoid valve.

3) As a result, the pressure in the blank end of the dump valve's relatively small volume decreases rapidly.

4) Thus, the dump valve moves quickly and exposes the large orifice at the blank end of the power operator.

5) Fast exhaust takes place at the blank end of the power operator; then, with the accelerating force of the compressed air in the reservoir acting on the rod end of the power operator, the closure seal is drawn to its fully closed position.

6) A pneumatic cushion softens the homing of the seal.

When the procedure is reversed, the blast closure is opened.

Although the specifications and use of these valves are highly exotic, the design is essentially simple. It is a variation of the basic poppet valve, using an elementary circular seal, standard linear motion dynamics.

The closure valves were designed and developed under the direction of the Air Force's Ballistic Missile Division. Participating members of the contracting team included the Bechtel Corp., Henry Pratt Co., and Armour Research Foundation of Illinois Institute of Technology. ⌗

# Nuclear Space Transportation Seen Feasible Within Decade

## *Douglas' Johnson tells Congress of four-step plan for total system; argues that cost is justifiable*

NUCLEAR-POWERED transports that are recoverable and re-usable can be developed within 10 years, and the nation that gets them first will dominate space, a leading missile/space engineer told Congress recently.

This is the real opening of the "new frontier," R. L. Johnson, chief engineer of Douglas Aircraft Co.'s missile and space systems, told the House Committee on Science and Astronautics. He declared that nuclear power "for economical space transportation is a far different operation than the current marginally justified (non-nuclear) program."

A vigorous nuclear transport development program would solve an entire class of space transport problems simultaneously, Johnson said, and therefore should be given a degree of funding which is substantial compared with that committed to any of the other systems which are by nature suited only for limited—for example, orbital —operations.

The nuclear transport is expected to serve three functions: (1) a truck device carrying objects into and out of orbit; (2) a lunar round-trip transport, and (3) an interplanetary exploration and transport vehicle.

"The vast possibilities of space, either for military or other applications, will only be scratched until an effective transport is operational," Johnson told the Committee.

He explained that by "effective" transportation systems "we imply economy of operation, convenience in terms of travel schedules, ease of maintenance and versatility of utilization.

**• Justifiable costs**—The Douglas engineer maintained that if a proper device is used space transportation is not expensive.

Based on an already demonstrated specific impulse, said Johnson, the lunar-cargo transport cost of the reusable rocket is only slightly more than ten times the cargo transport cost for cargo delivered halfway around the earth by DC-8. "Compare this with the costs associated with non-reusable chemical systems of more than 500 times the DC-8 unit cost," he advised.

These are only the direct operating costs. Johnson estimated that probably over a billion dollars might be needed to build reusable nuclear engines of the reliability needed for its work. Granting that this is a large amount of money, he observed that it is "not particularly different in magnitude from the development price required to bring about the jet-engine revolution in aircraft, or the development of large liquid chemical engines."

He calculated that for a nuclear-engine development price of a billion dollars, less than 400 tons delivered to the moon would completely amortize the development price of the nuclear vehicle.

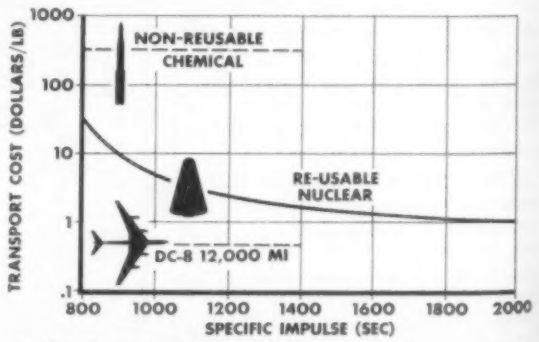
**• Four-stage program**—Urging that a total nuclear transport system be developed, rather than merely a nuclear rocket system, Johnson proposed four steps to bring this about.

First, there should be early work on recovering vehicles specifically designed for the nuclear transport mission.

Next, the *Rover* engine, for which a competition is now being held, should be used in a suitable ground and *Saturn* flight-test program. The experience gained here would be useful in solving the transport problem.

Third, the engine developed under the *Rover* program should be upgraded to the 200,000-lb.-thrust class; there must be improvements in its specific impulse and thrust-to-weight ratio.

Finally, when a cluster of four of these engines is available—or there is a single engine of about 750,000 pounds thrust—a nuclear-powered space transport should be designed. ⌗




*CARGO TRANSPORT COST for the lunar round trip.*

# IR Transducer Brings New Advantages

***Electro-Optical unit offers way to detect and resolve radiation at minute angles, can be aimed electronically***

**by Charles D. LaFond**

A NEW INFRARED transducer now in advanced development promises to aid greatly in a whole range of detection, measurement, and even guidance and communications applications.

An outgrowth of the Radiation Tracking Transducer (RTT) announced last year by Electro-Optical Systems, Inc., Pasadena, Calif., the unit has similar characteristics but responds to radiation in the intermediate and far IR range (3-6 micron wavelengths).

The early RTT employed a silicon cell offering a sensitivity range in the visible-to-near IR spectral range (0.5 to 1.1 microns). This and the new cell, which uses indium-antimonide (InSb) in a cryogenic environment, employ a lateral photo-effect associated with illuminated semiconductors to measure radiation intensity with microsecond response time.

Its developers feel that these detectors can provide characteristics not available in more conventional optical tracking or measuring sensors:

– Units are capable of detecting and resolving angular position of light or other forms of radiation (depending on the detector material) at angles of motion smaller than 0.1 second of arc.

– Cells can be aimed electronically, thus making mechanical rotation unnecessary (permitted by the use of wide angle optics in the telescope configuration).

• **Background**—The original RTT was developed for the Army Ballistic Missile Agency, Redstone Arsenal, Huntsville, Ala. This device is now being manufactured and marketed by Micro Systems, Inc., a subsidiary of EOS in San Gabriel, Calif.

Both the InSb and the silicon cell detectors are used with standard x-y recorders to give accurate position data in one plane along one or two axes.

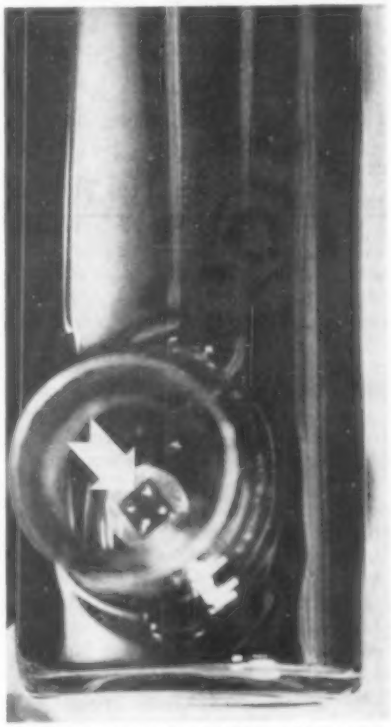
The new IR responsive units have been under development at EOS for the past 9 months as a company-sponsored project.

• **Lateral effect employed**—The RTT employs a light-spot position solid-state transducer. Essentially a two-dimensional output device, it consists of a broad, thin p-n junction having two pairs of connections on the n-layer.

When illuminated by a radiant source within its response range, the p-n junction experiences the development of a voltage proportional to the radiation intensity. This is a much-used photovoltaic effect.

However, the illuminated p-n junction also develops a lateral photovoltage in the presence of non-uniform radiation. This voltage changes in amplitude and in phase as the illumination transverses the photocell surface. This is the lateral photo effect discovered by J. T. Wallmark of RCA and first reported in April, 1957.

For spot displacements up to ± 20% of cell diameter, the lateral voltages (two directions) can be made proportional to the x-y displacement of the light spot with reference to the cell center of symmetry—(x, Y) and ($V_x$, $V_y$) all equal zero.



*INFRARED RADIATION tracking transducer (RTT) under development by Electro-Optical Systems, Inc., senses angular position to 5 microns in microsecond response time. Indium-antimonide cell (arrow) is housed here in liquid nitrogen dewar.*

In the EOS silicon-cell configuration, the p-n junction employs a low-resistivity p-layer and a high-resistivity n-layer. Under illumination, hole-electron pairs are developed in both regions, but the field at the junction sweeps the holes into the p-region and electrons into the n-region. Electrons spread out laterally and recross the junction because of the radiation-supplied forward bias. Potential distribution in the n-layer is radially symmetrical about the light spot and can be calculated.

Cell output is proportional to both the intensity and the position of the illuminating spot. Tests have shown that the measured effect of several spots is the linear superposition of the effects of all the individual spots. Thus, EOS states, the cell will respond to the "center of gravity" of a general intensity distribution on its surface.

More simply stated, the output generated by a single spot against a uniform background equals that of the spot alone. With a single spot and a non-uniform background, cell output is a function of the spot position and background configuration.

Many improvements have been made since the first RTT was developed. Voltage drifts with time have been measured for long periods at room temperature. Originally these ranged from 2.5-3.5 mils over several days, but this has been improved by a magnitude, says EOS.

Drift amount to 1% of a 0.280-in. full scale is now down to 0.05-0.1%. This was achieved largely by hermetically sealing the cell.

However, without significant increase in uniformity of the semiconductor body, EOS feels non-linearities of 7% of full scale remain a limit for linearity improvement.

• **Range extended**—Current efforts by EOS to extend spectral response have centered on the use of indium-antimonide. Units now under test respond to infrared wavelengths from 3-6 microns.

Other semiconductors with special doping are being studied for use in 8-14 micron range.

InSb detector temperature of 77°K

*SILICON RTT, developed originally for the Army, is shown with mounted lens system. Responsive to visible and near-IR illumination, it is adaptable to tracking, instrumentation, and even computer techniques. New cell uses indium-antimonide.*

(liquid nitrogen) was employed early in the investigations, but with improvements in sensitivity liquid carbon-dioxide cooling (195°K) has been used successfully.

Two principal designs have been used. One is essentially the same as that used in the silicon cell; that is, it employs low resistivity in the n-type base device. The other uses a high-resistivity, n-type base, but radiation is received by the p-layer of each to take advantage of the longer diffusion length of electrons as the minority carriers.

Both responsivity and detectivity have been found lower in the first design. While the second configuration appears clearly superior, fabrication of cells so far has followed that of the first design. Available materials and junction-forming techniques are only suitable for that structure, according to EOS.

A development effort now underway has been concentrating on new approaches to fabricating the second design.

Units fabricated for test purposes to date have used a thin wafer of n-type InSb with the p-n junction produced by diffusing zinc from the vapor phase into the material

The finished cells are 0.015-in. thick and the ohmic contacts on the n-layer are 0.200 in. apart.

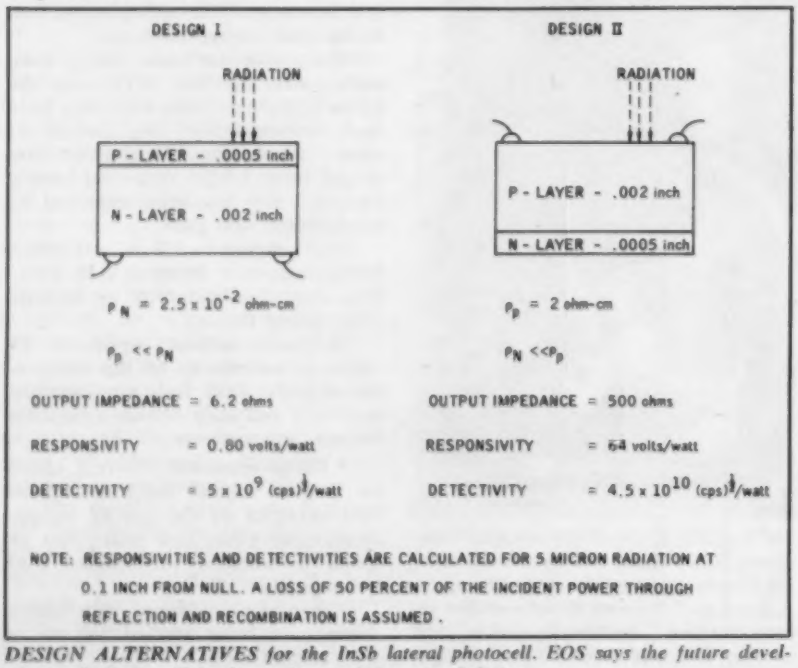
• **Broad usage seen**—EOS engineers stress that the new cells are strictly developmental at the present time. However, considerable enthusiasm for the transducers has developed in both industry and the military because of the varied uses of such devices. Here are just a few already being considered: guidance and control or horizon seekers for satellites or other spacecraft, celestial navigation, missile or aircraft tracking, missile launch orientation, target ranging location of ground light flashes, CRT direct-readout recorder.

The units are believed adaptable as high-speed multiple vector summing devices for computer applications. They could permit fast accurate measurement and inspection of parts and processes for automation control.

The most recent suggestion, and one now being studied seriously by EOS, is the use of the RTT or its IR successor for specialized communications on the ground or in space with a laser system.

A variation of the RTT cell is now being used by Jet Propulsion Laboratory as a photo pickoff for its new miniature accelerometer, only 1.5 cubic inches in total volume. The pickoff for the sensor is 1 by 2 millimeters in area. It uses a narrow field angle, but achieves very high sensitivity.

Army uses for the silicon-cell RTT are still classified. ⌘


DESIGN I
RADIATION
P - LAYER - .0005 inch
N - LAYER - .002 inch
$\rho_N = 2.5 \times 10^{-2}$ ohm-cm
$\rho_p << \rho_N$
OUTPUT IMPEDANCE = 6.2 ohms
RESPONSIVITY = 0.80 volts/watt
DETECTIVITY = $5 \times 10^9$ (cps)$^{\frac{1}{2}}$/watt
DESIGN II
RADIATION
P - LAYER - .002 inch
N - LAYER - .0005 inch
$\rho_p = 2$ ohm-cm
$\rho_N << \rho_p$
OUTPUT IMPEDANCE = 500 ohms
RESPONSIVITY = 64 volts/watt
DETECTIVITY = $4.5 \times 10^{10}$ (cps)$^{\frac{1}{2}}$/watt
NOTE: RESPONSIVITIES AND DETECTIVITIES ARE CALCULATED FOR 5 MICRON RADIATION AT 0.1 INCH FROM NULL. A LOSS OF 50 PERCENT OF THE INCIDENT POWER THROUGH REFLECTION AND RECOMBINATION IS ASSUMED.

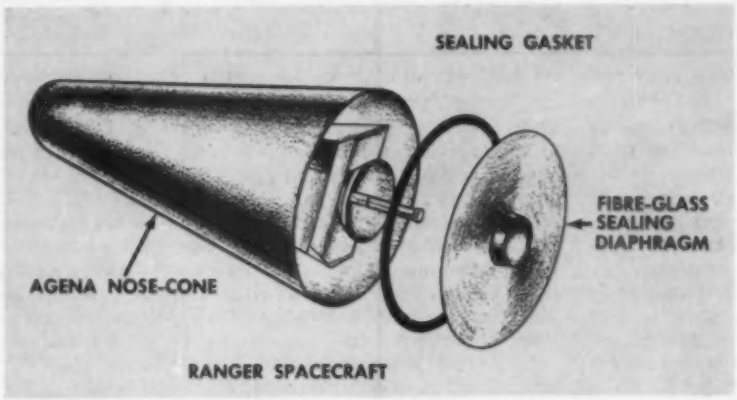
*DESIGN ALTERNATIVES for the InSb lateral photocell. EOS says the future developmental efforts will be directed toward the second design.*

# How Ranger Payload Is Sterilized

***Lockheed and JPL forced to redesign and compromise to meet added requirement; sterilizing future systems will come easier***

SPACECRAFT designers are facing the painful fact that they must "design in" sterilization now —or pay later for change and compromise.

Lockheed Missiles and Space Division, which worked with Jet Propulsion Laboratory on the first lunar payload, calls sterilization "the grand requirement in exploring celestial bodies."




*SEALED COMPARTMENT in Ranger protects payload from all contamination.*

The command for sterilization came early in the *Ranger* moon-probe program. The National Aeronautics and Space Administration has been increasingly concerned with the fear that "contaminated" spacecraft could wreak a scientific catastrophy by carrying earth microbes to the moon or planets (M/R, Feb. 20, p. 30).

The moon is generally thought to be an airless, barren body with no life of its own. However, there is one theory of the origin of life (though in some disfavor) which could be proven or disproven by investigation of the "moon dust" in its natural state. That is, that spores of living organisms drifted through space and seeded suitable planets. Some of these spores might still be preserved in the nooks and crannies of the moon. Without sterilization this chance could be lost.

Sterilization would not be such a necessity if it were possible to "fence off" the contaminated area around an impact point. Since the moon is almost totally lacking in atmosphere, there will be almost no frictional resistance to particles ejected on hard landing. So even bacteria-sized particles could spread to the far side of the moon, making identification of previously existing conditions impossible.

Unfortunately, design of the *Ranger* vehicle had already begun when the sterilization requirement was laid down. JPL and Lockheed had to design some changes and make some compromises to meet the requirement:

**by Heather M. David**

1) the existing nose cone on the Lockheed *Agena* had to be converted into a sealed-cavity spacecraft compartment, 2) in-flight hardware was developed for aseptic venting and maintenance of biological sterility, 3) a surface sterilization gas-transfer system was designed for ground support.

• **Adaption of nose cone**—A diaphragm or bulkhead of very thin fibreglass was designed to fit between the payload compartment and *Agena* stage of the *Atlas-Agena B*, completely sealing off the nose cone compartment. (Ford Aeronutronic is contractor for the lunar landing capsule.)

After the interior of the enclosed vehicle is sterilized with gases, no part is touched by human hands.

The nose cone eventually will be jettisoned at altitude high enough to prevent atmospheric contamination, but at velocity low enough so that it is left behind.

Since the compartment is airtight, a special pressure relief valve had to be designed into the diaphragm. A Bobrick multiflapper relief valve was chosen, Albin M. Nowitzky wrote in a Lockheed report. The valve provides a gradual adjustment of pressure during ascent, since there are experiments on the spacecraft which cannot sustain sudden pressure change, even if from a very low pressure to zero during the nose cone separation phase.

The valve prohibits inward flow. It is designed so that normal handling inertial loads will not open it, but after the first few minutes of boost it opens by virtue of boost acceleration.

In addition to the valve, a special breathing outlet was installed so pressures will remain stable during temperature changes incurred in filling with sterilization and purging gases.

The breathing outlet is covered with a special biological filter designed by the Millipore Corporation of New Bedford, Mass. Two .45 micron filters separated by ½ inch of fibreglass are used now, but improved Millipore filters are being considered. Flow rate is high since the ratio of pores to solid matrix is 80% to 20%. Each square centimeter of surface contains about 50 million pores, through which no particle larger than 0.80 micron can pass.

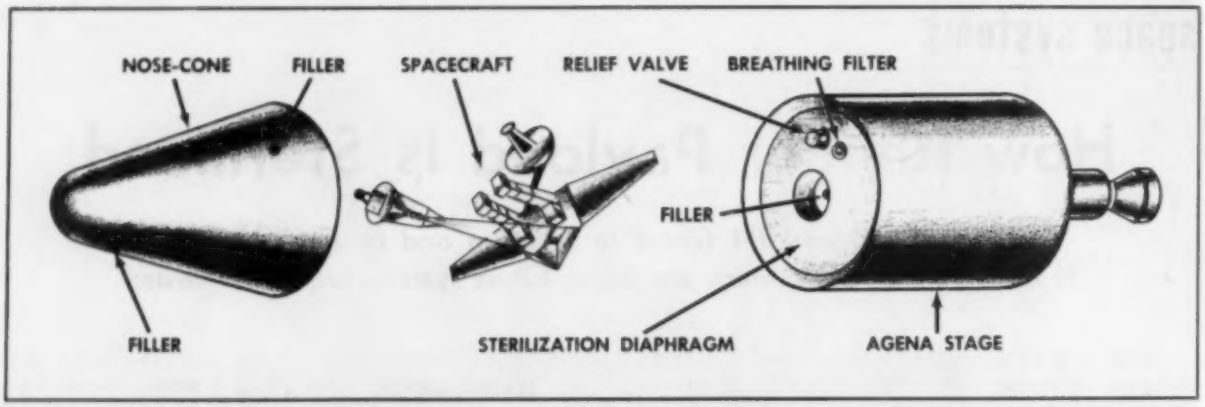
Nowitzky said that huge electrostatic charges are created when air is passed through the filter discs, because of the high dielectric constant, the large electric surface resistivity and the very low capacity for moisture absorption. This electric field gradient provides a high level of collection efficiency, he reported.

The bulkhead also contains a filler valve through which sterilization and purge gases are introduced. A James, Pond, and Clark circle seal check valve is used. In addition, the shroud contains outlet ports near the top to permit expulsion of gases.

• **Component sterilization**—Nowitzky reported that a "new look" had to be taken at vendor component specifications. Some of the problems he listed:

–Guidance and control: what will be the effect of sterilization on lubricants and intricate mechanisms?

–Optics: what about Lyman Alpha telescopic equipment, microscopic de-




*SEPARATION OF RANGER lunar probe will take place at altitude high enough to prevent atmospheric contamination.*

vices and other apparatus requiring control of lens environment and focal length considerations?

–Communications: electron tubes, solid-state transmitters and receivers, capacitors and other electronic equipment will have special problems.

–Life detection sensors: these may require special housings allowing only inflow at moment of sampling, and which would be compatible with outside surface sterilization.

JPL biologist and sterilization expert George Hobby reported to NASA that the group is considering a time-heating schedule for components of 24 hours at about 255°F under dry heat conditions. Materials which are labile to the heat treatment will be irradiated with gamma radiation at dosage levels of $10^7$ roentgens.

As substructures are bolted on to the spacecraft superstructure, each surface will have to be sterilized. If parts are replaced or disassembly takes place, the surfaces will have to be resterilized. Sterilization of contacting surfaces and screwholes during assembly and testing phases is still a problem, Hobby said.

• **Gas sterilization**—A mixture of 12% ethylene oxide inerted with 88% Freon-12 is used to sterilize the entire system. The mixture enters a gas vaporizer from supply bottles in the liquid state, then travels through a humidification group where a water heating and fogging device introduces humidity (25%±5%).

The sterilization gas passes through a test plenum before entering the payload cavity. Gas pressure, temperature and relative humidity are checked. The breather filter is sealed during the filling operation.

After an 8-14 hour soak period, (the *Ranger* cavity is 164 cu. feet), the sterilization gas is purged with either nitrogen or helium gas. These purge gases, much lighter than ethylene oxide mixture, effect a considerable launch-weight saving. The purge gas is passed through a previously sterilized bacteriological filter assembly, also provided by the Millipore Filter Corp. Purging takes about a half hour, Lockheed said.

As the sterilization gas is pumped from the system, it is combined with water and hydrochloric acid for disposal. Maximum allowable concentration of ethylene oxide in the air is 25-100 parts per million. It is more toxic than chloroform and carbon tetrachloride, but less harmful than hydrogen chloride and sulfur dioxide.

Lockheed advises that personnel exposed to the gases wear chemical safety goggles and have respirators available.

After the purge gas is introduced, the filling apparatus is aseptically removed from the nose cone and the openings are sealed. Until time of boost, inward breathing takes place only through the filtered passage.

George Hobby indicated to NASA that sterilization of future impact systems, such as *Surveyor* and *Prospector*, might be easier. He said the problem could be solved if a spacecraft that could be heated in entirety could be built. Then the whole device could be sterilized under the sealed shroud in a single operation after all assembly and testing had been completed. ⌗

## Three Firms to Study Post-Saturn Vehicles

NORTH AMERICAN Aviation, Georgia Division of Lockheed Aircraft and Convair Division of General Dynamics will make comprehensive, parallel six-month studies of space vehicles beyond the *Saturn* class.

Under contracts awarded by Marshall Space Flight Center, National Aeronautics and Space Administration, the companies will study vehicles with booster thrust of 6 to 12 million lbs.

Comparative cost analyses will be made for each proposed configuration. The most promising will be chosen for further study. Among the configurations studied will be solid-liquid and chemical-nuclear combinations.

Considerations will include the optimum use of nuclear propulsion, desirability of attempted recovery and reuse of large rocket stages, attractiveness of liquid hydrogen and LOX as propellants for a booster stage, and comparisons of the value of solid and liquid propellants, tandem and parallel staging, and pressure-fed and pump-fed systems.

Contract amounts are North American $160,041, Lockheed $136,743 and Convair $130,017.

NASA did not say what areas each company would emphasize. In the past, however, North American spokesmen have favored a nuclear upper stage atop a booster stage based on the conventional liquid-propelled F-1. Lockheed sources have indicated they favor a nuclear stage atop a solid booster. Convair spokesmen have proposed a combined nuclear-chemical rocket that burns LOX and hydrogen and then diverts the hydrogen through a nuclear engine after the relatively small LOX supply runs out. ⌗

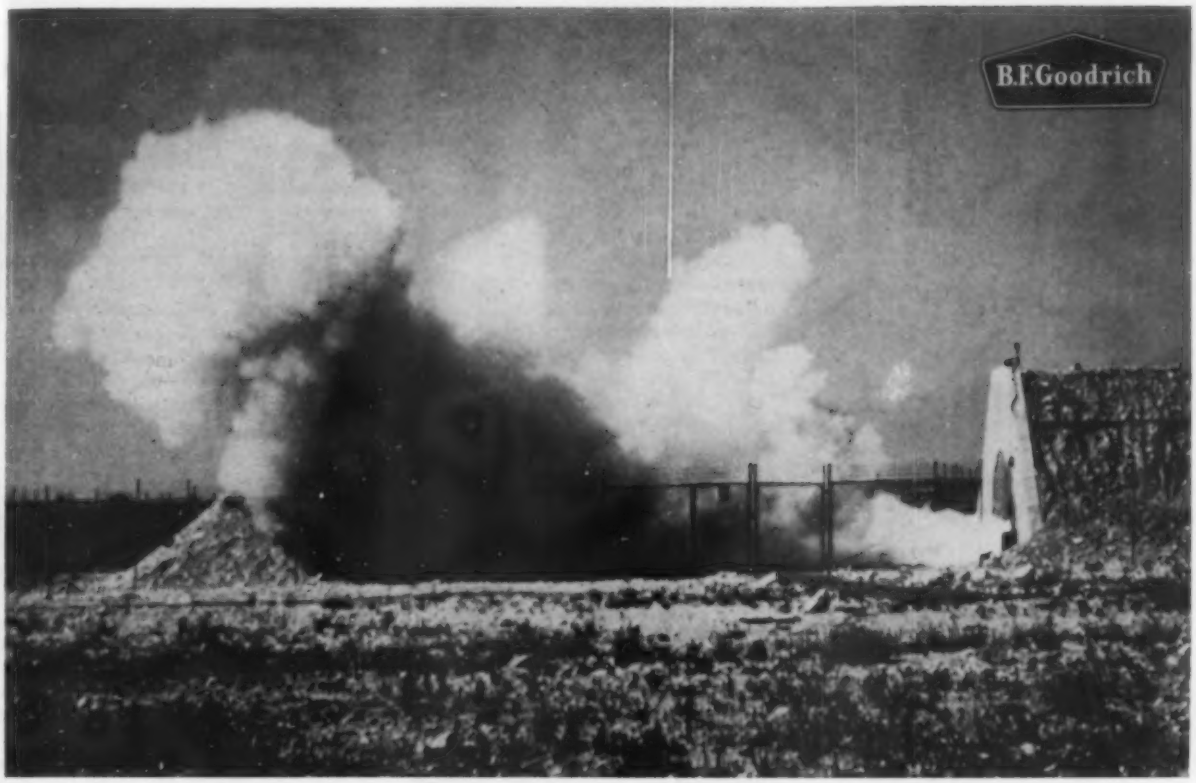
## New Propellant Will Raise Scout Capacity One-third

THE ONE-YEAR PROGRAM to uprate the *Scout* third and fourth stages for the *Super Scout* launch vehicle will cost $1.35 million.

The National Aeronautics and Space Administration has completed arrangements for transferring funds to the Navy for the propulsion development, to be carried out at Allegany Ballistics Laboratory, operated for the Navy by Hercules Powder Co.

The major change will be replacement of the current double-base propellant with a more modern formulation, similar to that used in Hercules' upper stages for *Minuteman* and *Polaris A2*. Fiber glass-plastic motor cases will continue to be used, with minor design changes.

The new propellant will increase *Scout's* orbital payload capacity from about 150 lbs. to a little over 200 lbs. ⌗



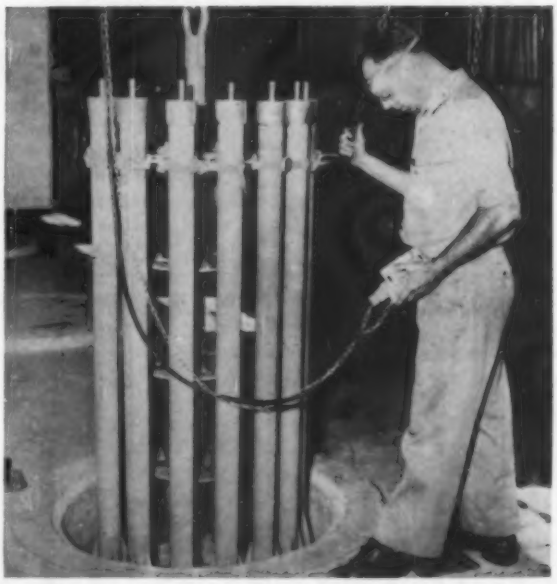

# B. F. Goodrich producing high-energy solid propellants

This static test tunnel is one of the 56 specialized facilities at the B. F. Goodrich solid propellant plant, Rialto, California. BFG-made propellants are currently being processed and loaded in solid fueled rocket motors of the LOKI, RTV and ASP types.

B. F. Goodrich pioneered the development of the major polymeric binder-fuels now being used in our country's most advanced missiles... Liquid "C" synthetic rubber and polyurethane. BFG solid fuels are outstanding in their high energy performance, and have excellent castability, ideal physical properties at low and high temperatures, excellent burning characteristics and batch-to-batch uniformity.

B. F. Goodrich is qualified and equipped to handle complete rocket motor projects... from complete design through testing and shipment. BFG also produces rocket motor cases, case and nozzle liners and other parts in conjunction with complete propulsion systems. Test and production motors containing cast and case-bonded propellant grains in various sizes and weighing up to 2,000 pounds have been successfully manufactured and fired.

For complete information on how BFG solid propellant facilities can help you, write for a copy of the new booklet "B. F. Goodrich Solid Propellants for the Space Age". *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Department MR-3, Akron, Ohio.*



Lowering a rack of small rocket motors into curing pit at the BFG Rialto plant after propellant has been poured into the cases. B. F. Goodrich has been engaged in composite solid propellant research since 1952—in motor production since 1957.

**B.F.Goodrich aviation products**

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# Strength Of Castings Multiplied By Forging

***Armour finds press methods will vastly improve yield and stress; castings may find bigger missile/space role***

by John F. Judge

SPECTACULAR INCREASES in the strength of steel castings can be obtained by applying press forging techniques.

Metallurgists at the Armour Research Foundation, Illinois Institute of Technology, Chicago, improved the yield and ultimate tensile stress of AMS 5363A (18-8 stainless) steel by 400-600% and 200-250%.

The investigations may lead to increased use of castings in future missile/space work.

Sponsored by the Air Force's Aeronautical Systems Center, Wright-Patterson AFB, the study also showed that the forging of castings could lead to simplified forgings of complex shapes —particularly with exotic alloys.

Another potential advantage is that the anisotrophy of the forging mechanical properties would be lessened. A part subjected to complex stresses, involving transverse as well as longitudinal loads, could perform better than a forging made from bar stock, which exhibits a directionality of properties before the forging sequence has commenced.

Since the transverse properties decrease as the amount of working increases, the researchers conclude that wrought-forged products in many instances would be inferior to a cast-forged product.

Three different alloys were involved in the program—SAE 4340, AMS 5363A and 17-4 precipitation-hardening stainless steel. Some increases in the physical properties of SAE 4340 were obtained.

The researchers conclude that SAE 4340 composition is not entirely suited to the press forging methods used in the study. The steel's continuous cooling transformation characteristics under stress do not make it amenable to ausforming-type strengthening in large section sizes.

The improvements with AMS 5363A were obtained by press forging at −100°F with 40% deformation, followed by tempering at 650°F. The 17-4 PH composition increased in both yield and ultimate tensile strengths by about 10%. This was achieved by deforming the predominantly martensitic structure 10% at room temperature, then aging at 860°F.

• **Industrial applications**—With respect to the two successful materials, Armour sees some difficulties with closed-die forgings at the relatively low temperatures involved. But careful die design, and possibly employment of massive rings around the die periphery, could alleviate these problems. Further, proper conditions of die design, part configuration and die constraint would make possible a single operation—instead of the three-step approach taken in the study.

Armour says the semi-open die press forging technique is immediately applicable. Selective press forging of highly stressed areas could readily be accomplished upon suitably designed parts.

The fundamental aspects of the project are definitely worth further investigation, says Armour. Three phenomena appear to be responsible for the oustanding property changes in AMS 5363A and 17-4 PH steels.

These are:

–Precipitation prior to martensite transformation.

–Formation of "martensite of deformation" as opposed to "martensite of cooling."

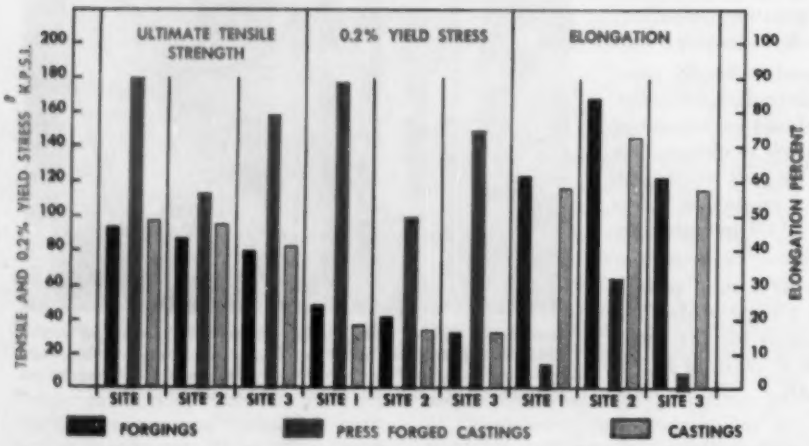
–Effect of deformation of martensite upon subsequent precipitation processes.

Armour recommends that combinations of the processes be included in any future work along these lines.

Most designers have opposed the use of castings in aircraft and missiles, usually because of the incidence of internal flaws and variable metallurgical quality found in many commercial castings.

But Armour says the improvement in the mechanical properties and concurrent overall increase in casting quality would render casting more acceptable.

The duplex process has the advantages of imparting higher tensile strengths and increases in yield and proof strength without the ductility increase associated with heat treatment alone. In addition, there is a relative freedom from the marked directional properties encountered in forgings, and a reduction in lead time and costs when compared to forgings for short-run or prototype parts. ⠿




*COMPARISON OF MECHANICAL PROPERTIES of AMS 5363A stainless steel. Specimens were taken from strut engine parts. Test bars were machined from three different locations within each specimen. Most deformation occurred at the ends of the parts, sites 1 and 3.*

# Hotter Furnace

## EOS Chamber Is Easily Expanded to Double Size

*HEATING AREA of the EOS furnace surrounded by tungsten element, tantalum foil shields.*

A HIGH-TEMPERATURE, high-vacuum furnace developed by Electro-Optical Systems Inc. can be expanded to twice its present size with only minor structural modifications.

The heating area is 7 in. high and 6 in. across. Limited redesign can expand this to at least 12 in. in height and diameter exceeding all known furnaces of its type.

Temperatures of 4700°F in a vacuum of $10^{-6}$ mm Hg are possible. Heating is accomplished by passing a 3000-amp current through a circular tungsten element surrounded by multiple layers of thin tantalum foil which act as heat shields.

Vacuum apparatus consists of a 46-CFM roughing pump and a 6-in. oil diffusion pump. The furnace can be reduced to $10^{-6}$ mm Hg pressure in about 4 minutes. It has a 30-in.-diameter outer dome of stainless steel, 30 in. high with four 6-in. ports on the side and a 12-in. port on top. This bell can be lifted completely clear of the furnace, providing easy access.

Additional heating area capacity can be obtained by increasing the size of the heat shields and tungsten element within the large outer dome.

The development of the furnace is an offshoot of EOS work on a demonstration ion propulsion motor for the Air Force. The project necessitated the brazing of porous tungsten ionization buttons to a molybdenum surface at high temperatures and vacuum. The uniformity of heating available in the device makes it ideal for high-temperature brazing of refractory metals.

In addition, it can be used for sintering metallic or ceramic compounds or as an environmental testing chamber. ⌗

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# new career positions with PAN AM

Pan American's Guided Missiles Range Division is now beginning its 8th year as prime contractor to the U. S. Air Force at Cape Canaveral. GMRD has successfully supported over 600 missile launchings, from early Snarks and Matadors to the present Pershings and Minutemen. Expanding requirements provide new career positions for qualified Electronics Engineers and Physicists. In addition to excellent company benefits, Pan Am offers the unique advantage of 90% world-wide air travel discounts.

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# Systems Must be Flight-Tested Soon

***GE's Zipkin says designers can't proceed realistically without further knowledge of effects of environment***

DEVELOPERS of large power systems for manned space missions are reaching the point where they must begin flight tests—or start marking time.

The problem is a lack of data on environmental conditions in space, which still pose major design and developmental difficulties. Designers have gone about as far as they can under simulated space conditions.

The need for flight testing was underlined at a recent meeting of the Institute of Aeronautical Sciences in Cleveland by M. A. Zipkin, manager of the General Electric Co.'s Space Power Operation.

Zipkin covered such considerations as lack of atmosphere, the forces on the system and the pressure of high-velocity meteorites.

Imposed design approaches were illustrated with reference to GE's 500 kw closed cycle, nuclear turbogenerator power supply—a system applicable to Department of Defense-National Aeronautics and Space Administration estimated power requirements for manned lunar exploration missions using the *Saturn* around Fiscal 1968.

Since the system will operate in a hard vacuum, all waste heat must be rejected by radiation. All shaft seals between working fluids and environment must be eliminated, and all materials with high evaporation rates avoided.

The important temperature is the effective sink temperature, said Zipkin. This is caused by radiant heat exchange among the sun, earth and satellite. It is a function of a number of variables including the ratio of absortivity to emissivity of the vehicle surface, the orientation of the vehicle with respect to the heat sources, and the geometry of the system.

Zipkin said the equivalent space sink temperature has very little effect on performance because space power systems have internally generated heat and high radiator temperatures. For example, a radiator operating at 800° F with a sink temperature of 100°F rejects about 5% less heat than it would with a sink temperature of absolute zero.

The anticipated forces on the power system will be negligible and it must be capable of operation under zero "g" condition. This aspect of the environment complicates the boiling and condensing processes and the operating of rotational machinery within the system.

• **Integrated design**—The structural arrangement of the 500 kw system is a cone with the nuclear reactor at the apex behind a shadow which protects the entire system against reactor radiation.

Forward of the shield are the circulating pumps, the heat exchanger, boilers, the turbogenerator with its associated turbine control valves, and the heat exchanger condensers.

A conical shell radiator extends aft of the turbo-machinery area. Two conical sub-cooler radiators are located forward of the main radiator and partially enclosed the turbo-machinery. All components and flow circuits are designed for longitudinal vehicle axis symmetry to minimize moment effects.

The system consists of three major flow loops, each with an associated subloop. Pressurized liquid-metal reactor coolant at 1800°-2000° F is circulated in the primary loop. In the boiler, heat is transferred to the two-phase power loop, which contains the wet vapor turbine, the heat exchanger condenser, and the condensate pump.

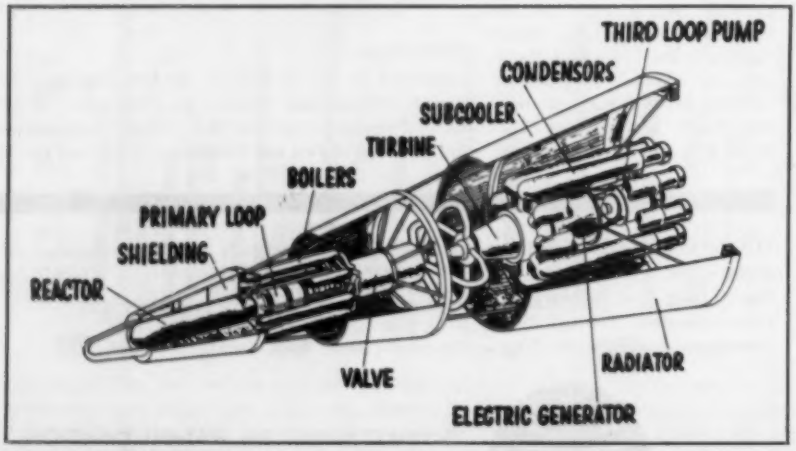
The condenser is cooled by pressurized liquid metal which is circulated by a motor-driven pump through the complex armored tube network of the radiator. Heat is rejected by radiation from the fin surfaces at the rate of about 2.5 kw/ft² at temperatures around 1200° F.

• **Artificial inertia forces**—In the absence of gravity, the sub-loops must perform the functions of pump inlet pressurization and circulation of motor and generator coolant and bearing lubricant. A centrifugal separator and a jet pump are employed to pressurize the inlet of the power loop condensate pump.

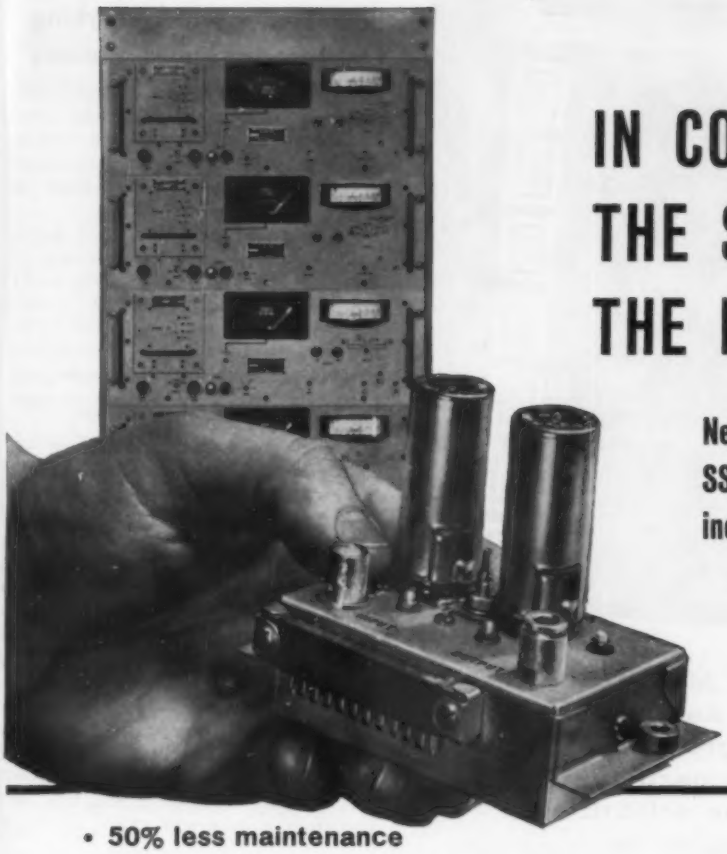
In the reactor and radiator loops, pressurization is achieved with small pumps and whirl chambers. The High temperatures and flow circuit complications are a direct consequence of the component design problems.

Zipkin said space power supplies are vulnerable to meteoroid erosion. Analysis shows that the greatest volume of material is eroded away by meteoroids that have masses below $10^{-7}$ grams. For these tiny objects, the data on impact frequency obtained thus far are too scattered for application to erosion estimates.

Besides the environmental factors, a number of stringent requirements have been imposed on the system. These include the volume and configuration restrictions imposed by the launching vehicle and the necessity for minimum weight without sacrifice of performance or reliability over a specified unattended operating life of at least 10,000 hours.




*GENERAL ELECTRIC's 500 kw closed-cycle, nuclear turbo space power package.*



# IN COMMUNICATIONS... THE SIMPLER THE BETTER

**New Hallicrafters all-modular SSB strip receiver cuts costs, increases reliability.**

- **50% less maintenance**
- **Far greater stability and reliability**
- **Down time almost entirely eliminated**
- **Lower initial cost**

Hallicrafters' new SX-116 SSB Receiver is the essence of simplicity—key to reliability in the Hallicrafters Series 116 communication system.

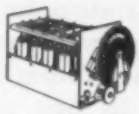
The SX-116 is entirely modular in construction, *virtually eliminating "down time" and cutting maintenance cost by over 50%.* The unit is quickly and easily adaptable to existing systems, entirely compatible with future requirements.

It is extremely stable—1 part in $10^6$ per month (standard) or 1 part in $10^8$ per month (special) . . . it permits, for the first time, continuous, unattended operation with *maximum reliability.*

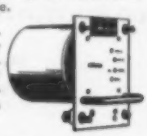
The SX-116 weighs in at just 36 lbs.—equally practical for fixed, mobile, air or seaborne installations. *And its initial cost is very substantially lower.*

Finding a better and simpler solution to complex communications problems has been a Hallicrafters habit for over a quarter-century.

**100% modular construction—only seven basic components**

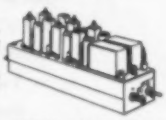


**RF Module.** Image and IF rejection maintained at better than 70 db. Single tuned circuit between antenna and RF grid. Four-channel, continuous tuning—2.0 mc. to 30 mc. range.



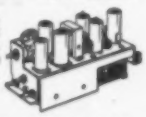
**HF Crystal Oscillator Module.** Stability: 1 in $10^8$ per month. Capacity is four crystals; designed for HC-6/U metal or glass crystal holders. Oven temp. varies less than ±0.01°C.

**Injection Amplifier Module.** AGC-controlled wide-band video amplifier provides constant injection level.

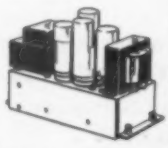


**IF Module.** Allows simultaneous reception of upper and lower sideband, independent AGC control of upper and lower sideband.

**BFO Module.** Operates at 1650.000 kc. Oscillator frequency stabilized in separate oven. Plate and filament voltages regulated.



**Audio Amplifier Module.** Features duel, independent 100-milliwatt line amplifiers. Hum level is 80 db. below 100 milliwatts. Harmonic dist. less than 0.5%.



**Power Supply Module.** Separate transformers provided for regulated and non-regulated voltages. Local oscillator and BFO filament supply are regulated for ±10% line voltage variations!

Write for complete specifications on the SX-116.

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## Soviets Reported Working On Hybrid Metal Process

A NEW TYPE of metal and alloy processing which simultaneously combines heat treatment, pressure working and magnetization is reported under development at the Moscow Steel Institute.

A magnetic field is applied during austenite-to-martensite transformation, bringing about (1) block fragmentation (by magnetostriction); (2) refining of fine structure as a result of the orientation of martensite crystals parallel to the direction of easy magnetization, and (3) domain arrangement of these crystals.

Thus the magnetic treatment significantly weakens the effect of former austenite grain boundaries on some properties of the steel, such as temper brittleness. In addition, the treatment reduces anisotropy caused by pressure working—since direction of easy slip (110) does not coincide with direction of easy magnetization (100).

Steel 45 (plain carbon steel with 0.42% to 0.50% carbon), water-quenched after being 19% strained at 1550°F in a magnetic field of 2000 gauss, showed a tensile strength of 352,800 psi, with yield strength about 12% lower. Elongation was 6% and reduction in area was 15%. ⁂

## GERSIS to Insure Safety In Nike-Zeus PMR Firing

A MODIFIED VERSION of the *Atlas* radio command-guidance system will be used for range safety instrumentation by Pacific Missile Range when *Atlas* ICBM's are fired to test the *Nike-Zeus* against real target warheads.

The General Electric range safety instrumentation system (GERSIS) will provide the range safety officer with instantaneous precise missile impact prediction to insure the safety of inhabited areas around the impact areas near Kwajalein Atoll.

General Electric has received a $3-million contract for installation and checkout of the system. Electro Steel Structures, Inc. was awarded a $585,-000 construction contract for the facility at Pt. Arguello. Construction began Feb. 1.

GERSIS is a high-precision automatic radar tracking system, developed by GE for the *Atlas*, in combination with a Doppler radio system. The data from this combination, when processed by a digital computer, will effectively and instantaneously measure the missile's velocity. The system will then supply complete real-time impact prediction and trajectory data for range safety purposes. ⁂

## Microdot Acquires 4 Space Age Companies

SOUTH PASADENA — Microdot, Inc., has recently concluded a planned expansion-through-acquisition program designed to broaden the product line and telemetry capabilities of its Instrumentation Division. Each of the acquired companies has been a highly successful, specialized manufacturer of electronic products. These companies are:

1) MICRO-TEST, INC., manufacturer of strain measurement devices. Through this addition, Microdot now offers the only high-temperature strain gage in the U. S.—a device capable of continuous measurement at 750° F. and dynamic test to 1500° F.

2) LERCO ELECTRONICS, INC., manufacturer of a wide range of electronic hardware, including molded terminals, terminal boards, handles, Mil-spec knobs, and many others. In all, Lerco catalogs over 380 standard part numbers.

3) NACIMCO PRODUCTS CO., manufacturer of temperature measuring devices and systems. Nacimco is the developer of a special method of producing miniaturized transducer sensing elements through the use of a unique deposited platinum film process.

4) SPECTRALAB INSTRUMENT CO., provides Microdot with outstanding capabilities in the field of VHF and UHF cavities and related instrumentation. This was the first company to have an operational UHF telemetry transmitter and continues to accomplish advanced work in the UHF telemetry field.

According to Microdot President R. S. Dickerman, "At Microdot we keenly feel a dual responsibility; first and foremost to make a positive contribution to the defense of our nation, and secondarily to show a satisfactory growth performance for our shareholders. We believe that we have served both purposes through our recent acquisitions. By strengthening our specialized capabilities, we are achieving a high degree of technological advancement, at utmost speed, with maximum economy."

**MICRODOT INC.**

220 Pasadena Ave.
South Pasadena, California

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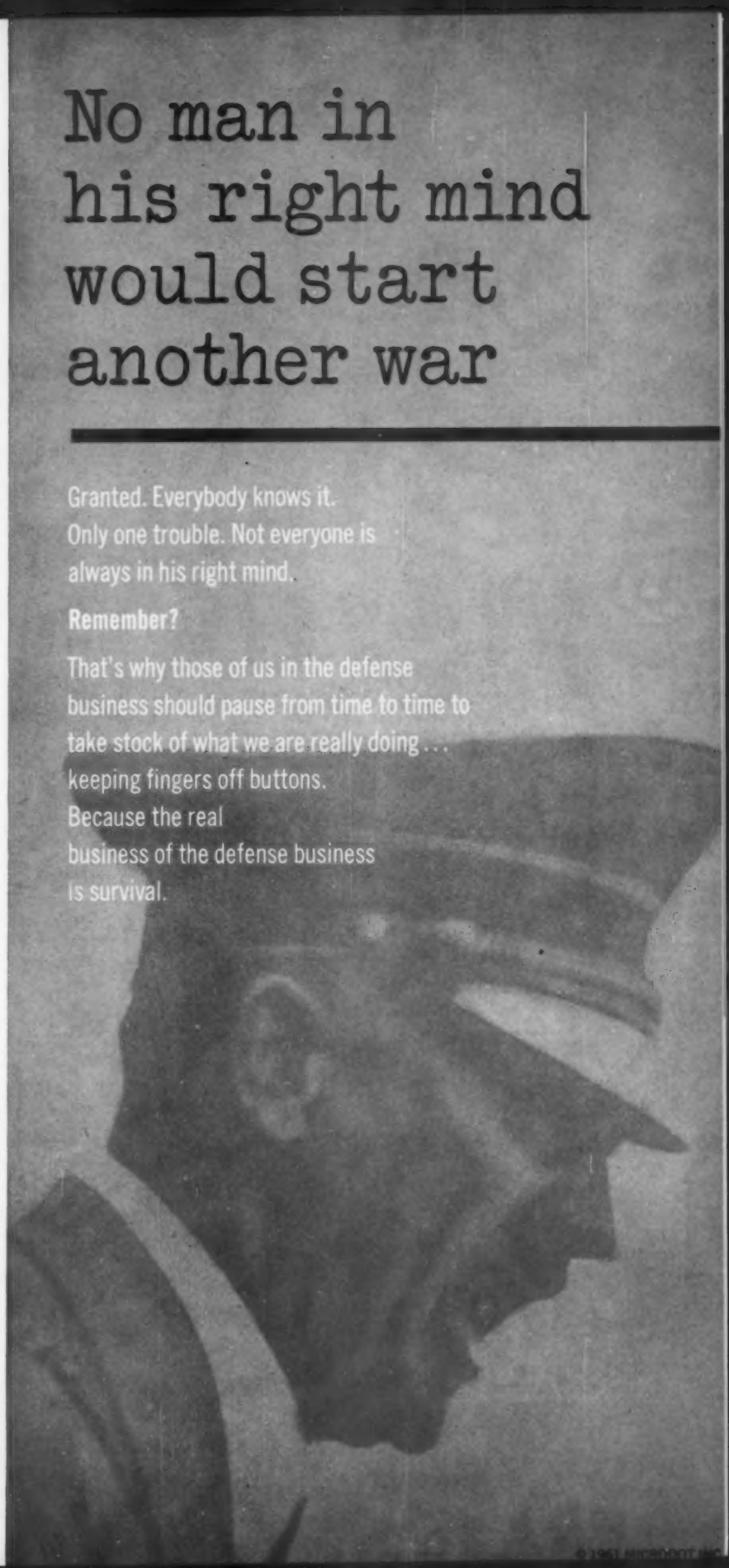
# No man in his right mind would start another war

Granted. Everybody knows it.
Only one trouble. Not everyone is always in his right mind.

**Remember?**

That's why those of us in the defense business should pause from time to time to take stock of what we are really doing . . . keeping fingers off buttons.
Because the real business of the defense business is survival.



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**What gives this system such speed? A 2-in. manifold and high capacity vacuum-operated valve in the test port station that permit full use of a 13 cu. ft./min. vacuum pump —*plus* superior vacuum geometry that gives the leak detector fast response.**

**By combining this remarkable test port station and leak detector, smaller components also can be leak checked... at the rate of one part every 8 seconds.**

**The 24-120 instantly locates leaks as small as $5 \times 10^{-11}$ atm./cc./sec. of air ($4.8 \times 10^{-6}$ micron cu. ft./hr.). Used independently, it provides proof of seals in all sizes of equipment, containers, and systems.**

***For more information, write for Bulletin CEC 24120-X8 or call your nearest CEC sales and service office.***

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## Mercury Hold-up

*(Continued from Page 15)*

cation of the capsule escape system before manned flight. The flight was actually part of the qualification for *Atlas*-boosted orbital flights and much more severe a test than could possibly be imposed by the *Redstone*. Nevertheless, it came at a point in time when success could assure more complete confidence in the system.

The test was largely a repeat of *Little Joe 5* last Nov. 8, in which the escape rockets fired but the capsule failed to separate from the booster as programed. The aim of the test was to fire the escape rockets at an altitude of about 35,000 ft. during powered upward flight, at a time when the forces resulting from speed through the air and atmospheric density exerted a maximum combined load squeezing the capsule back against the booster.

The escape was to be started by a signal that first opens the clamp ring holding the capsule to the booster and then fired the escape rockets. The system is designed to separate the craft from the booster by 150 ft. in 1 second. The parachute landing system then operates a few seconds later.

Analysis of the Nov. 8 flight showed that inadvertent operation of a small limit switch in the clamp ring fired the escape rockets after 15 seconds of flight, before any signal had been given to open the clamp ring. Thus, the capsule and booster remained joined together during the burning of the escape rockets.

On *Little Joe 6*, wiring was changed so that the escape rockets could not fire unless at least two limit switches actuated. The switches are loaded by spring pressure and operate when the pressure of the ring is removed.

Three other changes from *Little Joe 5* were made in *Little Joe 6*. They were:

–A large trapezoid-shaped window replaced two small round viewports on the *Little Joe 5* capsule.

–An on-board timer served as the system for starting the abort action after 35 seconds of powered flight. In *Little Joe 5*, after 25 seconds of flight, the abort initiation system was to be armed—to fire 10 seconds later. An on-board timing device was to serve merely as a backup. The change simplifies the electrical circuitry.

–The craft will carry a 4-ft. rubberized landing bag, which opens after the parachute is opened at 10,000 ft., to serve as air cushion on landing. The bag will be similar to that carried for the first time on *MR-2*, which broke off when the helicopter made the capsule pickup. ⌘

←—Circle No. 13 on Subscriber Service Card.

# "Delivery room" for a guidance system

Guidance systems and components for some of this country's most advanced ballistic missiles are being born in this room—and no hospital delivery room was ever kept freer from dust and dirt.

It's the "ultra-clean room" at Sperry Farragut—the cleanest of more than 5000 square feet of temperature-controlled clean-room facilities here. Its air locks and dust filters remove from the air all particles larger than 0.3 micron (12 millionths of an inch) and would stop cold the 3-5 micron bacteria dreaded in hospitals. Final assembly of guidance units for the MERCURY and SATURN missiles is carried out here—as well as assembly of a variety of other complex, precision mechanical and electro-mechanical equipment.

This clean room, probably the most advanced in the country in design and construction, is just one example of the ultra-modern facilities for precision military production at Sperry Farragut's 175,000 square-foot Bristol, Tennessee plant. These facilities are manned by a staff with outstanding technical competence and backed by the virtually unlimited capabilities of the Sperry Rand organization.

Our liaison engineers will welcome an opportunity to discuss application of Sperry Farragut facilities and capabilities to your requirements. O.2

*Capabilities and facilities for study, design, evaluation, prototype construction, and final quantity production of precision systems, subsystems, and components for:*

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- *Fire control*
- *Aircraft instrumentation*
- *Navigation—land, air and sea*
- *Computers*
- *Trail marking equipment*

SPERRY FARRAGUT COMPANY

DIVISION OF SPERRY RAND CORPORATION

BRISTOL, TENNESSEE

# 'Must' Stop for Missile Salesmen

***Commerce Department's Bureau of Foreign Commerce provides firms seeking to sell abroad with invaluable information—at nominal cost***

**by S. David Pursglove**

SAVVY U.S. MISSILE industry representatives are stopping off in Washington these days before they embark on sales missions to Europe.

They have learned that the U.S. Government spends more than $6 million a year to collect and distribute information which it supplies almost free of charge to American businessmen who sell, or hope to sell, overseas.

The source of this vital data is the Bureau of Foreign Commerce, an agency of the U.S. Department of Commerce, whose assistance is now sought by hundreds of missile and missile-related firms every year.

Sometimes the firms inquire almost casually about market potentials in certain areas—"How many Size 8 servomotors should we be able to sell annually in France, and who buys them?" Other calls come from near-frantic sales representatives—"Where on earth can we get clearance forms to ship seven sounding rockets to England; please explain Line Nine on my sample form; what the devil am I supposed to put on Line 14?"

The Bureau of Foreign Commerce (BFC) does not know how many missile industry firms it aids, because of varying definitions of "missile industry." However, among missile-related industries is the electronics and electrical components business; each week, BFC receives an average of 25 requests for help from this segment alone.

More often, BFC goes to the business community with notices of overseas sales opportunities, tariff changes, new port handling regulations, manufacturing licenses available or wanted.

BFC draws its information from nearly 300 commercial attachés in embassies and business reporters in consulates around the world. The reports are correlated, analyzed and supplemented by BFC "country experts" in Washington. In addition, information is obtained from embassies in Washington, visiting delegations and, finally, by overseas tours of BFC personnel.

Probably more than 90% of businessmen's questions are answered by BFC publications available at the 33 field offices, or through the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. There are three basic guides:

–"How the Bureau of Foreign Commerce Works for You" is a pocket-sized guide to BFC activities—what the Bureau can do for an individual or for his industry as a group, how to contact the BFC, where field offices are.

–"Guide to the Newcomer to World Trade" (15¢) also is helpful to the new man in the overseas division. It defines terms used in export-import affairs, briefly discusses generalized government controls, suggests items to investigate before seeking business and setting prices (e.g., goods may not always be shipped f.o.b. factory, quotations may have to be made f.a.s. United States port or c.i.f. port of destination).

–"Sources of Information on Foreign Trade Practice" (25¢) describes availability of authoritative publications in many areas—market analysis (and analyses available for many commodities and countries), economic statistics, regulations (customs, export-import, exchange, labeling), shipment preparation and transportation, finance, standards, trade terms, arbitration, trade directories, and trade organizations.

One of the missile industry's favorite basic primers on overseas business is "Channels for Trading Abroad" (25¢). Covering briefly the general business of exporting, this 24-page pamphlet also touches on several topics of particular interest to the missile-related or components firm—company organizations (built-in department, separate export department, international company), keys to market analysis, methods of selecting local reps.

The most popular BFC publication is "Foreign Commerce Weekly" ($6.00 per year). More than 10,000 U.S. businessmen subscribe to this comprehensive weekly report on all U.S. and foreign trade regulation changes, investment opportunities, sales leads and tips, construction project news, foreign visitor listings, invitations to bid, major loans, licenses available or wanted, and interpretive reports on countries and commodities.

*Even in government-to-government sales of strategic military items, the Commerce Department can aid the companies involved. Clearances and export licenses often are needed even in these cases. "Exporters Service" provides in-person help. Commerce is the businessman's voice in the Government, often can take his case to Pentagon or State Department to aid sale of military-type items in civilian markets overseas; can help businessman ascertain his chances of getting Defense-State okay, helps unblock bureaucratic barriers. Contact Office of Export Supply in Bureau of Foreign Commerce.*

• **Industry appreciation**—What is the missile businessman's attitude toward the work of BFC?

–Tyler Nourse, Electronic Industries Association: Our industry has been helped greatly through information supplied by BFC; country desks have been especially helpful. BFC has helped to ease considerably U.S. export (licensing) restrictions, especially on tubes and semiconductors. EIA members have found BFC's Office of Export Supply helpful in defining strategic components that need licensing. BFC always has served us rapidly with information on potential markets and NATO projects open for bids.

–An Aerojet-General official: Most missile firms have overlooked the help available from the Commerce Department "probably because they have been shooting for bigger things—assistance from the State Department or perhaps the NATO Standing Group—and don't realize that Commerce can greatly ease the day-to-day operations involved in doing business overseas."

–Donald Agger, American Nord-Aviation, Inc.: I can especially praise "Foreign Commerce Weekly" on its accurate reporting of the NATO Infrastructure developments. This is a several-hundred-million-dollar-a-year program that is rapidly moving from

the earthwork phase into sophisticated communications, semiautomatic data transmission and other areas of electronics. The "Weekly" provides rapid and full information for bidding. The Exporters Service office fills a real need in carrying out the bread-and-butter aspects of shipping even strategic materials.

(Exporters Service is a small office, in Room 3836, that helps the businessman determine the clearance needed to ship missile-related materials, supplies forms, and helps in their preparation.)

Other services to the missile industry offered by BFC: Trade lists, World Trade Directory Reports, and services in finding an agent abroad.

Trade lists ($2.00 each, per country) provide names and addresses of firms in a given nation that produce or import specific commodities. Included is company size, products handled, type of operation, sales territory, and a summary of conditions governing trade in the commodity involved.

World Trade Directory Reports ($1.00 each) contain information on individual foreign firms—names of principals, detailed business operations, preferred language of correspondence, credit report and references, etc. If BFC does not have a new report on the subject firm, or if you need a report on a firm never checked, BFC will run a comprehensive check.

Looking for an agent overseas? Give BFC your specifications and a State Department Foreign Service Officer on the scene will make a detailed investigation and report to you on the prospects. Surveys take about 60 days and cost $10.00 each. Apply for this service on Form FC-963, available from the nearest field office, or request it from Commercial Intelligence Div., Bureau of Foreign Commerce, U.S. Dept. of Commerce, Wash. 25, D.C.

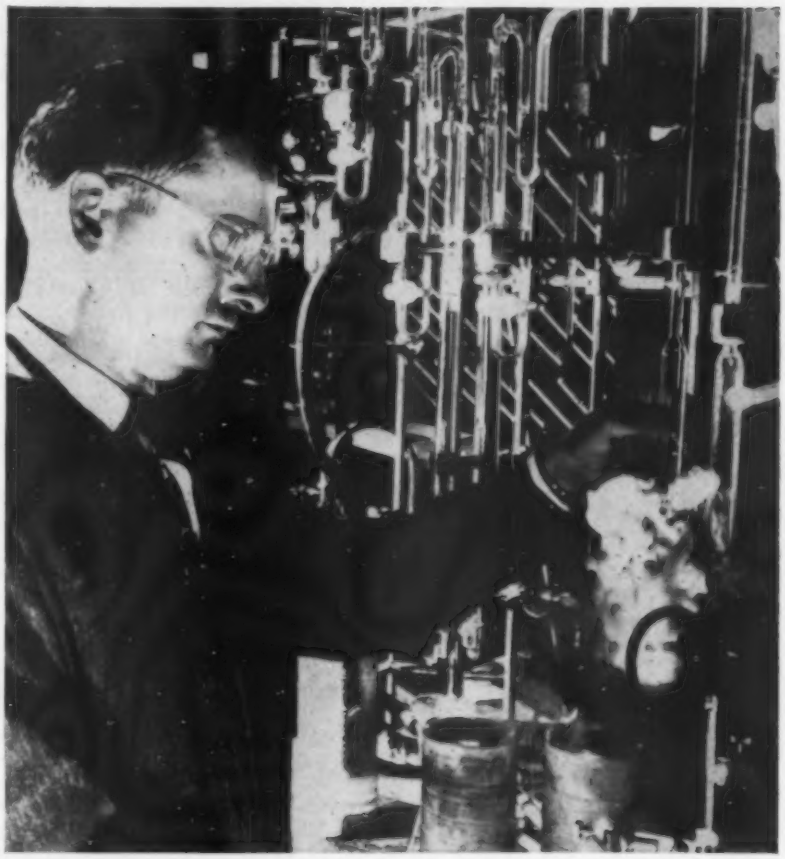
The Bureau is located in the Commerce Department Building, 14th Street between Constitution Ave. and E Street, N.W. The following men, with their room numbers and extensions (Tel: STerling 3-9200) are country experts who can help on problems not answered by the publications (only a few key desks are listed):

United Kingdom—Deane Black, R 3065, Ext 2969; France—Robert Sarichm, R 3424, Ext 2323; Greece—Allen Garland, R 3846, Ext 2429; Italy—Howard Shepston, R 3411, Ext 3500; Netherlands—Stephen Conger, R 3427, Ext 2919; Belgium-Luxembourg—Robert Walker, R 3427, Ext 2337; Germany—Karl Koranyi, Ext 2424.

For names of other country experts, or for guidance to the appropriate office on other problems, contact Miss Faye Forbes, Office of Public Information, Ext 3681. ⠿


GALLERY

PROPELLANT BRIEFS



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This diversification of effort in the interests of National Defense can be helpful to you. A new laboratory and office in Encino, California, is providing closer liaison with the heart of the missile industry, and brings our capabilities to bear directly where they are most needed.

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For information or technical service write Defense Products Dept., Callery Chemical Company, Callery, Pa.; or telephone Evans City, Pa., 3510, Ext. 455.




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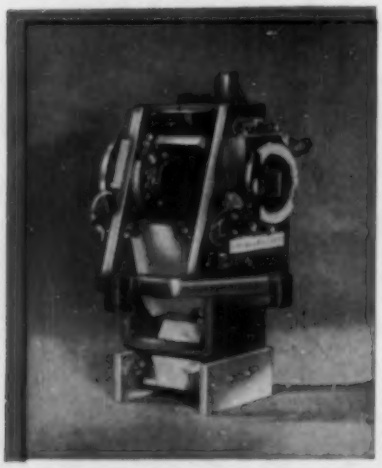
# PRECISE STAR TRACKER



A celestial navigation system called for a tracking device capable of establishing a line of position within an accuracy of 300 feet. Kollmorgen came up with a constant deviation elevation system that positions a movable mirror, in relation to the fixed elements, to a repeatable accuracy of better than 5 parts in a million.

This compact package represents a combination of highly precise optical and electronic units in a housing only 6 x 6 x 10 inches. Kollmorgen's project from concept to installation, it is a typical demonstration of the company's scientific, engineering and manufacturing skills in optics, electronics, mechanics. Example: the precision optics (a prism and two mirrors) are of Kollmorgen manufacture. So, too, are the Inland torque motor*, the gearing and other precision-machined parts.

Our motive in this message: Kollmorgen offers proven capabilities in optics, electronics and precision machining of metal components . . . capabilities which could solve your problems in missile tracking, fire controls, navigation, or . . .?

**Present us with a problem.**

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Circle No. 17 on Subscriber Service Card.


# soviet affairs

By Dr. ALBERT PARRY

**To focus or concentrate electromagnetic waves** over distances may be the aim of Soviet scientists now working on "electromagnetic rock-crushers." If this is the goal, and if the Russians succeed in reaching it, the potential for the Space Age may be tremendous. One of the first significant accounts of these experiments appeared last July 8 in the Moscow *Ekonomicheskaya Gazeta*, and was mentioned briefly in M/R, Oct. 24, 1960. Since that time, there have been two more Soviet press articles on ore-crushing and earth-exploding: in *Krasnaya Zvezda* of Dec. 11 and *Izvestia* of Jan. 19.

**The fact that the chief military newspaper** of the Soviet Union—*Krasnaya Zvezda*—takes up the subject of modern rock-crushing methods is quite interesting. It implies military uses of these "rock-crushing sparks," as well as peaceful industrial purposes. The *Krasnaya Zvezda* article describes experiments in which wires running through water are employed. It quotes L. A. Yutkin, a scientist connected with the Leningrad Polytechnic Institute who is in charge of this work, that "miniature lightnings cause a super-high pressure as they travel through the liquid and bring about a shock wave of destructive force." Instead of "electromagnetic" he uses the word "electrohydraulic."

**Extra-hard sulfide-quartz ores** of the Zyrianovsky Mine in East Kazakhstan (Russian Central Asia) were selected for some of the experiments discussed in this report in the main organ of the Soviet ministry of defense. The two engineers heading this work, A. Safronov and Yu. Kiselev, declare that results so far have been eminently positive. *Krasnaya Zvezda*, calling this method "the technology of tomorrow," cites Safronov's prediction: "Plants will get rid of hundreds of expensive mechanisms; thousands of workers will be freed for other tasks; productivity of labor will increase more than tenfold." Among other future developments, ships at sea will be moved by engines built "on such a principle . . . of electrohydraulic effect."

**Neither electromagnetic nor electrohydraulic methods** are mentioned in the *Izvestia* article of Jan. 19. This account stresses the necessity of throwing the exploded rocks or masses of earth to specific places, well defined in advance. It praises Professor George I. Pokrovsky for his achievements in such precise "targeting," saying that he "has made a prominent contribution to this cause" of "guided transfers of masses of earth" in explosions. The *Izvestia* article is entitled "Peaceful Explosions," but a well-informed reader will recall that Professor Pokrovsky is not only a doctor of the technical sciences, but also a major general in the engineering branch of the Soviet armed forces and a faculty member of the world-renowned Zhukovsky Military Air Academy in Moscow. Author of *Guided Effect of Explosion* and other standard books on the subject, Professor Pokrovsky is one of Russia's outstanding experts on long-range ballistic missiles. He was first introduction to the world at large in August and September, 1957, when he served as a foremost official commentator on Mascow's initial announcement of achieving a workable ICBM.

**None of these recent Russian articles** makes it clear whether the rock-crushing electrodes—be they magnetic, hydraulic, or of whatever other variety—are buried in, or in contact with, the rock they crush and the earth they explode and throw to its predestined sites. Such conductors may well be so buried or in such contact. However, they may already be operating at a distance, or, at least, Soviet scientists may be trying to make them work at a distance. If operation at a distance is indeed involved, the importance of these Russian experiments in the Missile/Space Age cannot be underrated.

## ARS, ASME Meet Concurrently in LA

LOS ANGELES—Size and reliability were keynoted at two technical meetings held here in the past week.

Huge vehicles contrasted with microminiature electronics, patterns of failure in components, and numerous other missile/space subjects were covered by the American Rocket Society and the American Society of Mechanical Engineers during three-day conferences held a few blocks apart.

Impatience with the current pace of space programs prompted several ARS speakers to call unofficially for replacing incremental progress with bold reaches.

R. C. Truax, of Aerojet-General Corp., pointed out that the German *V-2* was scaled up 336 times from its immediate predecessor in a near-successful bid to win World War II.

Truax, and J. D. Ryan presented a paper advocating large boosters launched at sea and recovered after use. They said feasibility could be proved by using *Aerobee* rockets.

Instantaneous course changes for space vehicles commanded from the ground was held out as a possibility by Robert E. Carlson, of Pacific Missile Range, who spoke on a real-time computer capable of providing in-flight data on a missile or space vehicle in a tenth of a second.

In the solid-propellant rocket field, Rudolph A. Peterson of Aerojet told the ARS that large-scale production of continuously mixed castable composite propellants might answer future demand for many high-thrust solid rockets.

A simplified method of picking up floating data capsules was described by Royal C. Schendel and Frank J. Brennan of the Navy Missile and Astronautics Center, whose proposal involved use of inflatable loops that would be snagged by a pickup hook from a plane.

In instrumentation, a paper presented by Alexander M. Voutsas of American Bosch Arma Corp. detailed a digital angle readout device capable of three-tenths second arc accuracy. It uses resonant frequency of a twisted beam or wire, varied with twist angle, to directly measure angular deviation.

In materials research, Ford Motor Co.'s Aeronutronic Division described its Ausform process of thermomechanically treating alloy steels to attain ultra-high strength levels. Strength-to-weight ratios of 1,000,000 in.-lb. per lb. are expected after perfection of the treatment, which is specifically tailored to production of rockets. The process mainly consists of deforming metals plastically while in the metastable austenitic condition.


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It also comes in perforated, triangular form for use as a line-wave generator for precision timing and other specialized applications. In this case the detonation initiated at any apex will proceed as a straight-line detonation zone to the opposite edge.

**Du Pont "Detasheet"** gives you design freedom unavailable with conventional explosives. Suggested uses include: destruct systems for classified components, separations, diaphragm rupture, destruction of spent propellant cases, perforation of rocket cases to change direction or velocity, etc.

For details on "Detasheet", contact your Du Pont Explosive Systems Specialist, by writing Du Pont, 2446 Nemours Building, Wilmington 98, Delaware.

* Trademark of E. I. du Pont de Nemours & Co., Inc., for its flexible sheet explosive.

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# contracts

## NASA

$2,000,000—**Astronautics Division of Chance Vought Corp.**, Dallas, for fuel and liquid oxygen tanks for the *Saturn* booster program.

$1,052,434—**Redstone Arsenal**, Huntsville, Ala., for services and supplies including fire protection, technical library services, pictorial services, vibration testing of *Saturn* components, rocket motors for use in the *Juno II* program, and establishment of vibration test program in connection with space vehicles.

$965,000—**Air Research and Development Command**, Andrews AFB, Washington, D.C., for additional studies and preliminary design of the S-V stage for the *Saturn C-1* vehicle by **Convair Astronautics**, and propellants for a 17,500-lb.-thrust engine.

$362,642—**Chrysler Corp.**, Detroit, for investigation of corrosion and corrosion prevention in the *Saturn* vehicle and to assure proper operation and highest possible reliability of tactical ground support equipment used in firings of the tactical *Jupiter* weapons system at Cape Canaveral.

$335,000—**Georgia Division of Lockheed Aircraft Corp.**, Marietta, for pressure and functional checkout equipment for the *Saturn* booster.

$321,201—**Hughes Aircraft Co.**, Malibu, Calif., for applied research, development, fabrication and experimental testing of an ion rocket engine.

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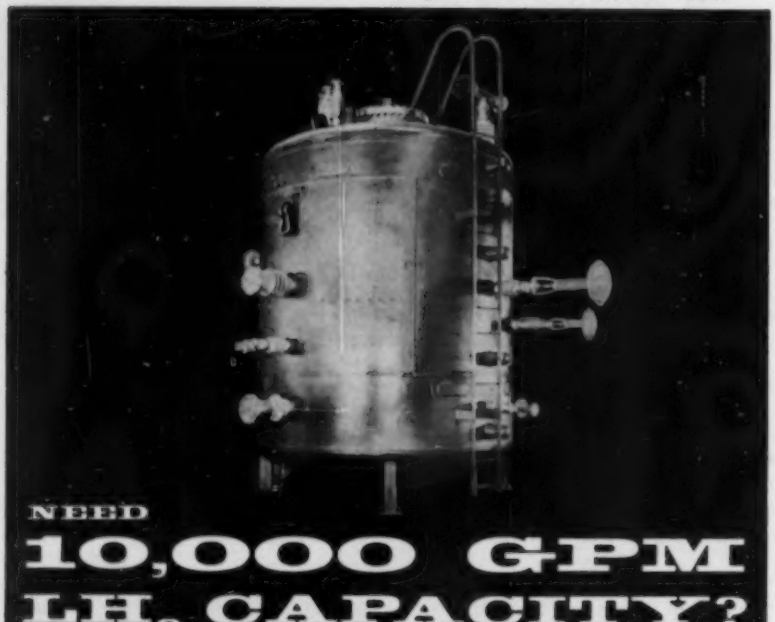


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$308,528—**North American Aviation, Inc.**, Downey, Calif., for conceptual design studies of space vehicles.

$226,796—**The Martin Company**, Baltimore, for heat exchanger coil assemblies and conceptual design studies of a space vehicle.

$130,017—**Convair Division of General Dynamics Corp.**, San Diego, Calif.; $136,743—**Lockheed Aircraft Georgia Division** at **Marietta**; $160,041—**North American Aviation, Inc.**, Los Angeles; for comprehensive studies of possible future space vehicles beyond the *Saturn* class, rockets having first-stage thrust of six to twelve million pounds.

$120,000—**Arnold Engineering Development Center, Air Research and Development Command, Tullahoma, Tenn.**, for space-vehicle wind-tunnel testing.

$119,160—**Electro Optical Systems**, Pasadena, Calif., for ionizer development, surface physics studies, and a study to determine flight test objectives for ion propulsion systems.

$59,945—**The Marquardt Corp.**, Van Nuys, Calif., for investigation of exhaust-nozzle flow phenomena in arc-jet engines.

$50,000—**Stanford University**, Stanford, Calif., for study of systems for space propulsion.

$44,411—**Plasmadyne Corp.**, Santa Ana, Calif., for study of flight-test objectives for electro-thermal propulsion systems.

$41,000—**The Wallingford Steel Co.**, Wallingford, Conn., for special alloys for Lewis Research Center, Cleveland, Ohio.

**The Astronautics Division of Chance Vought Corporation**, Dallas, for study of ways of assembling and launching space vehicles from an earth orbit. No amount disclosed.

**Radio Corporation of America, West Coast Missile and Surface Radar Division**, Van Nuys, Calif., for the *Saturn* ground computer system. No amount disclosed.

## NAVY

$14,000,000—**The Martin Company**, Baltimore, for production of *Bullpup* missiles.

$7,300,000—**Westinghouse Electric Corp.**, Baltimore, for development and production of the weapon direction equipment portion of the *Typhon* weapon system.

$141,000—**Planning Research Corp.**, Los Angeles, from **Lockheed Missile and Space Division**, for one-year advanced study program on the *Polaris* missile.

$50,000—**Atlantic Research Corp.**, Alexandria, Va., research to further develop the *ARCAS* rocketsonde system.

## ARMY

$1,328,000—**AiResearch Manufacturing Co.**, Phoenix, Ariz., letter contract for gas turbine generator sets for the *Sergeant* missile system.

**Dumont Manufacturing Corporation**, San Rafael, Calif., for all-plastic nozzles for the first and second-stage rocket motors of the *Pershing* missile. Subcontract from **Thiokol Chemical Corp.-Redstone Division**. No amount disclosed.

## AIR FORCE

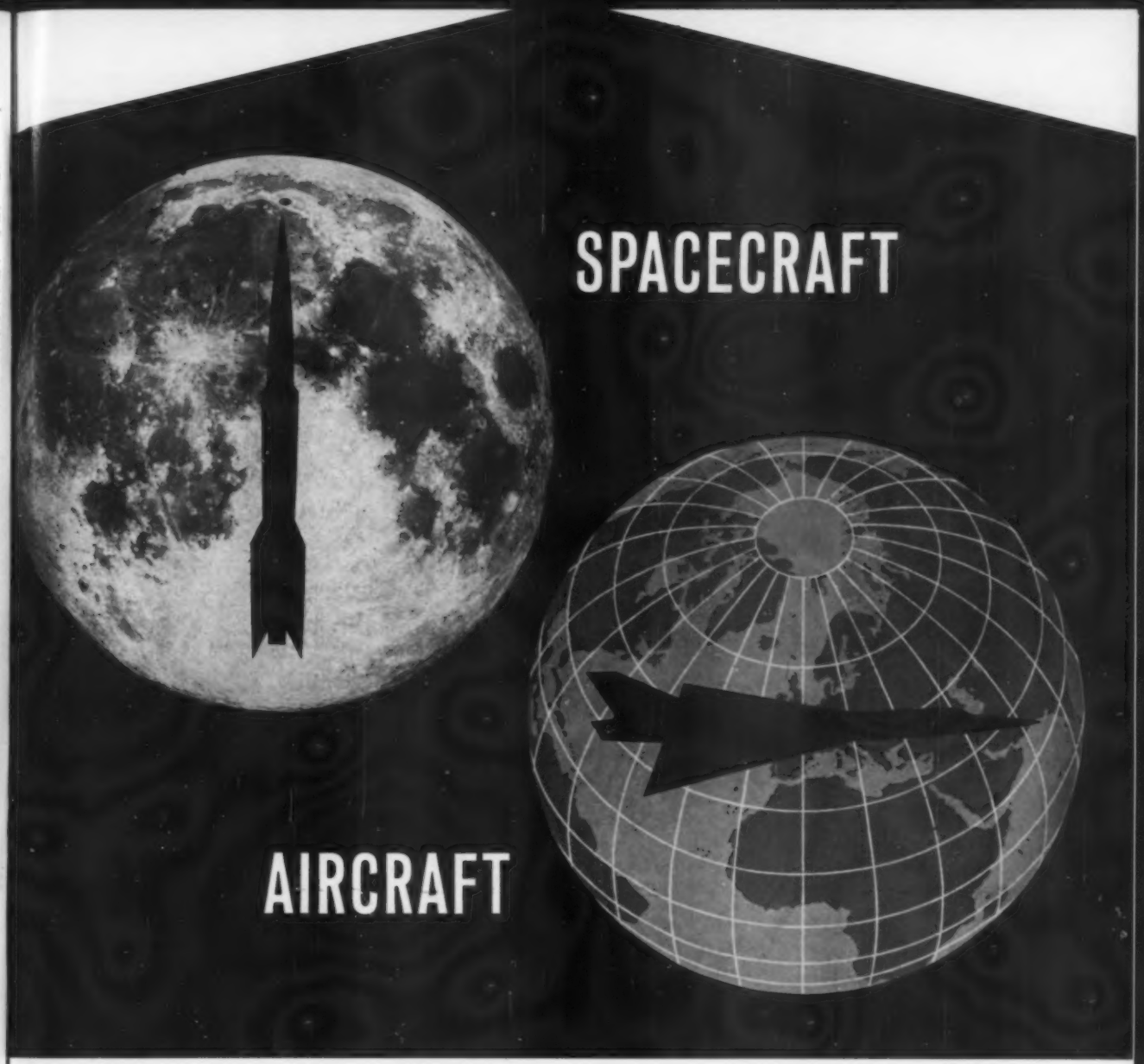
$28,000,000—**General Electric Company's Missile and Space Vehicle Department**, for development of the re-entry vehicle for the advanced *Titan II* ICBM.

$300,000—**United Control Corp.**, Seattle, for liquid-oxygen level indicating equipment for the fuel system of the *Titan* ICBM. Subcontract from **The Martin Co.**

$246,195—**Dynatronics, Inc.**, Orlando, Fla., for a telemetry predetection recorder, receiver and reproducer system for missile test requirements at AMR.

$200,000—**Microdot, Inc.**, South Pasadena, Calif., for precision temperature measuring systems for the advanced version of the *Titan* missile. Subcontract from **The Martin Company.**

$122,750—**Vitro Electronics, Division of Vitro Corp. of America**, Silver Spring, Md., for five airborne telemetry receiving systems for the Missile Test Center at Patrick AFB, Fla.

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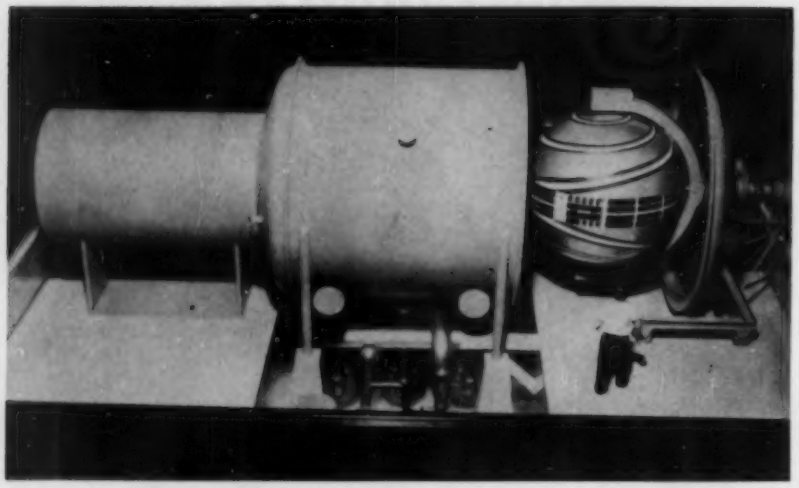
# products and processes

*Featuring "New Idea" electronic products introduced this week at the 1961 Institute of Radio Engineers' International Convention in New York City.*



## Satellite Orbital Simulator

An advanced orbital simulator, capable of testing an eight-foot satellite spinning in two directions, has been developed by the Aerospace division of Tenney Engineering, Inc.

The simulator will provide space thermal radiation levels and solar spectral radiation of variable flux, earth to Mars, as well as a special heat sink "black wall," refrigerated to –320°F with liquid nitrogen to absorb radiation and prevent bounce-back to the test object—exactly as in space.

The chamber, a stainless steel cylinder, will be 12 feet in diameter and 11 feet long. Pressure will be reduced to $1 \times 10^{-7}$ mm Hg, or 1,100,000 feet. The cryogenic system will dissipate a maximum heat load of 700,000 BTU/hr.

Circle No. 225 on Subscriber Service Card.

## Subminiature Tubes

Four high-gain, low-noise, subminiature receiving tubes utilizing a strap-frame grid construction are available from Sylvania Electric Products Inc.

Sylvania will display two medium mu UHF double triodes and two high mu UHF triodes. Features of the medium mu triodes, compared with their prototypes, are: one exhibits a 100% increase in Gm and Gm per milliampere of $I_b$, the other has 80% higher Gm at 40% lower plate voltage and 20% lower heater power. Features of the high mu triodes are: one has a 1300/1 ratio of Gm to $I_b$, while the other employs one-third the heater power with a 3db improvement in noise figure.

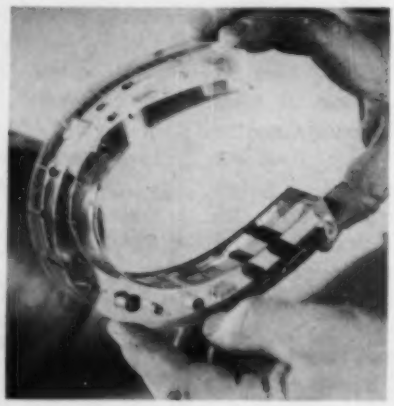
Circle No. 226 on Subscriber Service Card.

## Flexible Silicone Resin

A silicone encapsulating material that permits visual inspection of circuits and components within potted, embedded or encapsulated assemblies will be introduced by Dow Corning Corp.

Applied as an almost colorless liquid —after blending with its curing agent— Sylgard 182 cures in place even in totally confined enclosures, to form a transparent mass having outstanding dielectric properties, good moisture resistance and the physical attributes of flexibility and toughness.

Circle No. 227 on Subscriber Service Card.



## Battery Systems

Three battery systems are being developed by Yardney Electric Corp. One is a sea-water battery; another is a sealed form of rechargeable silver-cadmium battery; the third is a new automatically activated primary battery system having a minimum of parts and offering maximum flexibility in packaging.

Circle No. 228 on Subscriber Service Card.

## Traveling Wave Tubes

Two compact metal-ceramic traveling wave tubes designed to operate as the driver and final amplifier in a pulsed high-power chain are now available from General Electric Corp. for X-band radar applications.

Type Z-3090, the driver tube, covers the 8500-to-9600 megacycle frequency range and has a peak power output of 10 kilowatts. Power gain is 35 db, efficiency 15%, and maximum duty cycle 0.005. The tube also can be used as a final amplifier in a medium power application.

The amplifier tube, type Z-3091, covers the 8600-to-9600 megacycle range and has a peak power output of 500 kilowatts. Power gain is 20 db, efficiency 25%, and nominal duty cycle 0.004.

Circle No. 229 on Subscriber Service Card.

## Readout Photocells

A series of silicon readout photocells providing very fast response time (from 5 to 20 microseconds), capable of reading 10,000 characters per second

in perforated tape and punched card data reading systems, is available from International Rectifier Corp. The cell series is available with 5, 6, 8, 9 or 10 readout positions, with an active cell area (per segment) of 0.128 x 0.067 in., and center-to-center spacing of 0.087 in.

All units provide extremely high sensitivity, operation to 150°C, and very low noise output. Typical current generated is 350 microamperes for 0.01 sq. in. of active cell area at 1000 foot-candles illumination.

**Circle No. 230 on Subscriber Service Card.**

## Microwave Antenna

Technical Appliance Corp. have available microwave antennas and a rigid coaxial transmission line.

The Antenna line includes frequency ranges from 806 MC to 12.7 KMC. Reflector sizes range from 2 to 12 feet, depending on frequency range. A highlight of the line is 12-ft. mesh reflectors available in the 900 mc and 2000 mc frequency bands.

The transmission line is offered with a choice of copper or aluminum outer conductor. Standard EIA flanges or TACO "Quick Clamps" may be provided.

**Circle No. 231 on Subscriber Service Card.**

## Microcomponent Pellet Assembly

A microminiaturization technique which shrinks circuit elements to pellets 1/10 in. in diameter and 1/16 in. high will be demonstrated by P. R. Mallory & Co. Inc. Mallory engineers will use pellet resistors, capacitors and diodes in combination with conventional miniature transistors to fabricate binary dividers in the form of microcircuit logic blocks.

The microcomponents fit into holes


CIRCLE SEAL precision valves

# PRECISION VALVES

*...the valve that is guaranteed not to leak!*

Design and application experience gained in developing and manufacturing truly leakproof valves has enabled Circle Seal to earn and retain its position of leadership. Advanced design concepts based upon extensive experience and investigation make Circle Seal valves the ultimate in quality and reliability. These time-proven concepts, incorporated in the valves below are designed to help you select the *right* valve for your specific application.

## CIRCLE SEAL VALVES FOR AIRCRAFT, MISSILE AND GROUND SUPPORT REQUIREMENTS

| | Aircraft | | | | | | | | | Missiles & Rockets | | | | | | Ground Support | | | | TYPICAL VALVE TYPES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fuel | Pneumatics | Hydraulics | Purge & Inerting | Oxygen | Water & Alcohol | Lubricating Oil | Fuel | Oxidizer | Pneumatic Control | Hydraulic Control | Cryogenics | Electronics | Packaging | Control Panels | Inerting System | Hydraulic Control | Pneumatic Control | Fuel Handling | STANDARD | SPECIAL |
| Automatic Drain | ● | | ● | | | | | ● | | | | | | | | | | | | | P7-526, P19-526 |
| Bleed, Manual | | ● | ● | ● | ● | | | | | ● | | | ● | | | | ● | | | | P12-228, P4-416 |
| Check, Low Pressure | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | 800 | P6-620, P3-319 |
| Check, High Pressure | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | | | ● | ● | ● | ● | ● | | 200/2100/2600 | |
| Check, Restricter | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | | | ● | | ● | ● | | | | P-649, P9-649 |
| Check, Modulor | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | ● | | | | P1-278, P5-356 |
| Check, Vent Port | ● | ● | ● | | | | ● | ● | ● | ● | ● | | | ● | ● | ● | ● | ● | | | P4-673, P-698 |
| Check — Relief | ● | | ● | | | ● | ● | ● | | ● | ● | | | | | | | | | | P-389 types |
| Checkout, System | | | | | | | ● | ● | ● | ● | ● | | | | | ● | ● | ● | | | P1-425, P2-425 |
| Drain, Automatic | ● | | | ● | | ● | | ● | ● | | ● | | | | ● | | | ● | | | P7-526, P19-526 |
| Drain, Manual | | ● | ● | | | | ● | | ● | | | | | | | | ● | | | 9200 | P-394, P-427 |
| Filler | | ● | ● | ● | | | | | ● | | | | | | | | ● | | | | P4-308, P4-691 |
| Fill & Bleed | | | ● | ● | | | | | ● | ● | | | ● | | | | | | | | P20-228, P1-427 |
| Gauge Protector | | | | | | | | | | | | | | ● | | | | | | 1100 | |
| Relief, Low Pressure | | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | 500 | P12-352, P4-637 |
| Relief, High Press. | ● | | | | | | ● | ● | | | ● | | | ● | | ● | | ● | | 5100 | |
| Relief, Modulor | | | ● | | | ● | ● | ● | | | ● | ● | | | | ● | | ● | | | P4-648, P7-349 |
| Relief, Thermal | ● | | ● | ● | | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | | ● | | | P12-352, P27-220 |
| Relief, Vacuum | ● | | ● | ● | | ● | ● | ● | | | ● | ● | ● | | ● | | | ● | | | P-262, P2-534 |
| Selector, Manual | | | | | ● | ● | | | | | | | | ● | | | | | | | P7-418, P48-395 |
| Shut-off, Manual, H.P. | | ● | ● | ● | ● | ● | | | ● | ● | | | | ● | ● | ● | ● | | | 900 | P15-350, P6-406 |
| Shut-off, Manual, L.P. | | ● | ● | ● | ● | ● | | | ● | ● | | ● | | ● | ● | ● | ● | | | 9200 | P3-395, P45-395 |
| Shut-off, Vacuum | | ● | | ● | | | | | ● | | | ● | | ● | ● | | ● | | | 9200 | P3-395, P45-395 |
| Shuttle | ● | ● | | | ● | | | ● | ● | ● | ● | ● | | ● | | ● | ● | ● | | 400 | P-652, P-702 |
| Vacuum Breaker | ● | | ● | ● | | | ● | ● | ● | | ● | ● | ● | | ● | | | ● | | | P-262, P2-534 |
| Vent & Breather | ● | | ● | ● | | | ● | | | ● | | ● | ● | | ● | ● | | ● | | | P-249/P-262, P5-308 |
| Vent, Float Actuated | ● | | | | | | | | | | | | | | | | | | | | P-401, P5-401 |

Typical standard lines of off-the-shelf type valves based upon proven Circle Seal design concepts are shown below:

**200 SERIES CHECK VALVE**

The one perfect answer for virtually any check valve requirement.
- Zero leakage, 0-3000 psi
- Low cracking pressure
- Adaptable to most fluids
- Unequalled reliability

Technical Data Form #35-2044B

**2100 SERIES CHECK VALVE**

Advanced check valve design utilizing the proven Circle Seal Principles in high pressure pneumatic systems.
- Zero leakage, 0-3000 psi
- Exceptional durability
- Designed to withstand surge flows
- Compact, light weight

Technical Data Form #35-2283

**2600 SERIES CHECK VALVE**

Precision check valve performance in minimum package size.
- Versatile pressure range, 0-3000 psi
- Minimum size and weight
- Suitable for any mounting position
- Maintenance free reliability

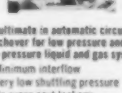
Technical Data Form #35-2284

**800 SERIES CHECK VALVE**

The one perfect answer for applications requiring a combination of low pressure drop and zero leakage.
- Zero leakage, 0-600 psi
- Low cracking pressure, low pressure drop
- Suitable for any mounting position
- Not affected by "O" Ring swell

Technical Data Form #35-2044B

**400 SERIES SHUTTLE VALVE**



The ultimate in automatic circuit switchover for low pressure and high pressure liquid and gas systems.
- Minimum interflow
- Very low shuttling pressure
- No cross-port leakage
- Absolute reliability — accurate shuttle response

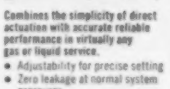
Technical Data Form #35-2242

**500 SERIES RELIEF VALVE**

A precise reliable combination of small size and full flow capacity.
- Zero leakage virtually to cracking pressure
- Reseat dead tight, close to cracking pressure
- Opens freely without sticking
- Maximum flow — minimum size

Technical Data Form #35-2145R

**5100 SERIES RELIEF VALVE**



Combines the simplicity of direct actuation with accurate reliable performance in virtually any gas or liquid service.
- Adjustability for precise setting
- Zero leakage at normal system pressures
- Smooth, chatter-free operation
- Minimum hysteresis

Technical Data Form #35-2118R

**900 SERIES SHUT-OFF VALVE**

The one perfect answer for system shutoff where leakage cannot be tolerated.
- Zero leakage, 0-6000 psi with gas or liquid
- Metered opening to protect system
- Low operating torque
- Maintenance-free operation

Technical Data Form #35-2238

CIRCLE SEAL precision valves

**JAMES, POND & CLARK, INC.**
2181 East Foothill Boulevard
Pasadena, California

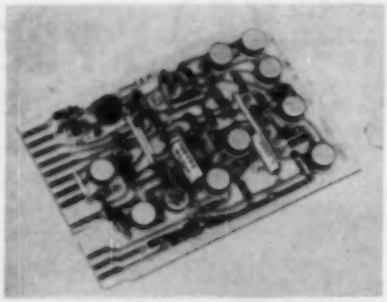
**Circle No. 20 on Subscriber Service Card.**

in component boards, along with terminals which are pressed into slots along the edges of the boards. A printed circuit pattern on each board is connected with pellets by conductive cement; the boards are then cast into transparent epoxy blocks measuring 1 in. x .85 in. x .14 in. Completed units are then plugged into a binary adder for testing.

Circle No. 232 on Subscriber Service Card.

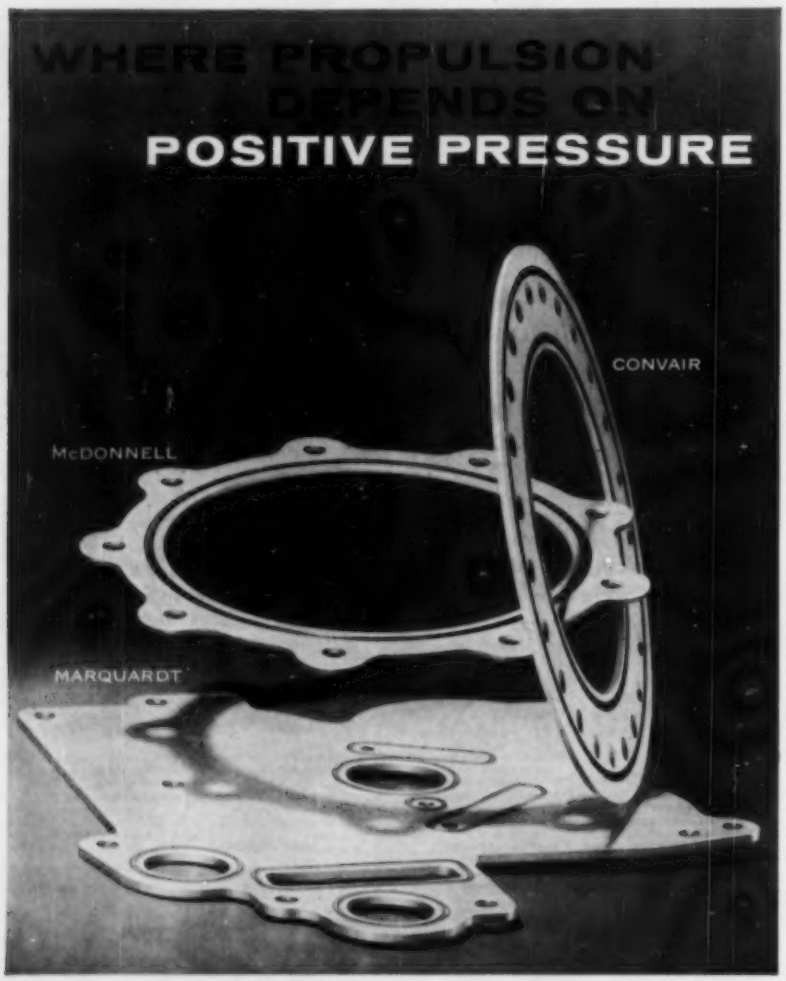
## Operational Amplifier

An operational amplifier specifically designed for exceptionally reliable operation is now available from Donner Scientific Co.



The solid-state amplifier, Model 3801, uses silicon transistors throughout to provide both the high-gain, wide-bandwidth path and the chopper-stabilization path. In standard form, the Model 3801 will operate over a temperature range from 0°C to +55°C in a relative humidity of 95%. It will withstand shock of 30 g and meet all specifications to an altitude of 50,000 feet.

*ERRATUM: The above is the corrected version of a product release which appeared in the Feb. 6, 1961, issue of M/R.*


Stillman meets "Space Age" requirements with the same reliability and product perfection that has earned them a name for dependability throughout the aircraft and missile industry for many years. Stillman products fly with the jets. They are also integral parts of the fuel and hydraulic systems for many of the advanced weapon systems. Engineering, research and development, and progressive designing enable Stillman to meet the challenge of the space age.

**STILLMAN RUBBER COMPANY**

CULVER CITY, CALIF. / CLEVELAND, OHIO / ENGLEWOOD, N. J.

Circle No. 19 on Subscriber Service Card.


# new literature

SHAFT ENCODER—An eight-page technical brochure on shaft encoder translation is available from Harvey-Wells Electronics, Inc. The engineering-type discussion describes in detail the operation of the two basic models of shaft encoder translation equipment manufactured by Harvey-Wells Electronics. The two descriptions are supplemented by logical block diagrams and timing diagrams.

Circle No. 200 on Subscriber Service Card.

MICROWAVE—Microlab has made available a catalog of microwave components. This catalog consists of 72 pages and includes detailed descriptions and specifications of their line of coaxial attenuators, filters, power dividers, terminations, crystal mounts, tuners and other coaxial microwave components.

Circle No. 201 on Subscriber Service Card.

BLIND NUT—A solution to the problem of blind fastening is described in a product bulletin published by Standard Pressed Steel Co. It covers the SPS Davis press nut. The literature reviews the principle of operation of the unique one-piece, flush-mounting nut; suggests possible applications, principally in airframe, missile and comparable sheet metal applications; and details general specification data.

Circle No. 202 on Subscriber Service Card.

SEALED SWITCH—A one-page data sheet covering Catalog Listing 41HR1-S has been released by MICRO SWITCH, a division of Minneapolis-Honeywell Regulator Co. It includes details of construction, characteristics and electrical rating, and prices.

Circle No. 203 on Subscriber Service Card.

LEAKPROOF CHEMPUMPS—A four-page bulletin released by Chempump Division, Fostoria Corp., describes the Series G Chempump, its automatic thrust balance, extremely large bearings, oil-filled stator cavity and other exclusive features. Bulletin 2050 also includes complete performance curves and a detailed cross-section of a new line of canned pumps.

Circle No. 204 on Subscriber Service Card.

# names in the news

**Lucien J. Donadieu:** Formerly engaged in the development of a superconducting magnet for the National Science Foundation and M.I.T., appointed special consultant to Cryoflux program at Magnion, Inc., Cambridge, Mass. **Milton Raymond** to head Magnion's ultra-high-field pulsed magnet design and **John Tracey** engaged for mechanical design of the new Plasmaflux air core and Uniflux iron core magnet lines.

**Adm. Joseph J. Clark (USN-ret.);** Appointed executive director of Solitron Devices, Inc., Norwood, N.J.

**William R. Bidermann:** Appointed chief production engineer of Telecomputing Corporation's Whittaker Gyro Division, Van Nuys, Calif. Among the missile programs on which the company is participating are *Bullpup, Shillelagh, Polaris, Nike-Hercules, Skybolt* and *Nike-Zeus.*

**George C. Rayner:** Named assistant to the president of Allied Chemical's General Chemical Division, New York.

**Robert R. Beachler, Jr.:** Corporate director of engineering, elected vice president of Leach Corporation, Los Angeles, and appointed general manager of the Relay Division.

**August Nuut:** Named vice president of engineering for special products at American Missile Products Co., Inc., Los Angeles.

**T. L. Maltby:** Promoted to weapon system manager—XKD2B-1/Q-12 missile target system for Beech Aircraft Corp., Wichita, Kan. **George R. Selig** appointed executive project administrator-all military projects. **Ed C. Nikkel** appointed weapon system manager-B-70 alert pod program, and **Roy H. McGregor** appointed manager-contract administration.

**Maj. Gen. Albert Boyd (USAF-ret.):** Vice president and general manager of Westinghouse Electric Corporation's defense products divisions, honored with the highest award the company gives its employees, the Order of Merit, for "vision and leadership which have inspired throughout Westinghouse a better understanding of defense and space problems." Prior to joining Westinghouse, he was Deputy Commander, Weapons Systems, Headquarters, ARDC.

**Bernard B. Smyth:** Appointed assistant vice president of General Atomic Division of General Dynamics Corporation. He will be in charge of General Atomic's office in Washington, D.C.

**Frank Seay:** Vice chairman of the SWIRECO '61 general committee and Dallas I.R.E. section representative to the SWIRECO board, appointed assistant to the president of the Graduate Research Center in Dallas.

**Albert R. Conrad:** Appointed manager of Electro-mechanical Engineering, Computer Products Operations, at Ford Motor Company's Aeronutronic Division, Newport Beach, Calif. **Roger L. Sisson** appointed manager, Program Analysis, Technical Staff.

**Roy W. Murray, Jr.** and **Edward J. Weiss:** Named director of marketing and director of contracts, respectively, for Radiation Incorporated, Melbourne, Fla. Before joining the company, Murray was western regional manager for Tele Dynamics, Inc. and Weiss was consultant to USAF's Directorate of Weapon Systems while with the Wright Air Development Center.

**T. R. Finch:** Named assistant general manager of Motorola's semiconductor products division, Phoenix, Ariz. Before joining Motorola, he was special systems development engineer for Bell Telephone Laboratories, Murray Hill, N.J.

**Richard D. Moroney:** Former supervisor of balloon flight operations for General Mills, Inc., named project engineer for the G. T. Schjeldahl Co., Northfield, Minn., where he will participate in the company's stratospheric balloon and high-altitude research programs.

**Dr. Nathan Marcuvitz:** Appointed vice president for research at Polytechnic Institute of Brooklyn. Former director of Polytechnic's Microwave Research Institute and supervisor of its electrophysics group, he has also been for the last 12 years electrophysics consultant to NYU's Institute of Mathematical Sciences.

**George E. Holmes:** Placed in charge of SUBROC and rocket production planning and control for Goodyear Aircraft Corp., Akron, Ohio. **Henry H. Nettling** named assistant to Holmes.

**Harold B. Finger:** Appointed assistant director for nuclear applications in NASA's Office of Launch Vehicle Programs. He will continue as manager of the joint Atomic Energy Commission-NASA Space Nuclear Propulsion Office.

**William R. Corliss:** Engineer at The Martin Company's Nuclear Division, Baltimore, appointed consulting editor on propulsion for the McGraw-Hill Encyclopedia of Science and Technology. Before joining The Martin Company, he was an engineer on the aircraft nuclear propulsion program at Pratt & Whitney Aircraft and a space propulsion systems specialist for General Electric Co.

THE STANDARD OF CALIBRATION

A sensitive dead weight pressure balance for use as a primary pressure standard. Repeatability in excess of 0.01%.

Ranges up to 12,000 psi with subdivisions as small as 0.1 psi.

Designed to calibrate a wide selection of pressure-measuring devices, the gage is adaptable to almost any pressure-measuring problem. Complete pressure testing and calibrating installations assembled to meet customer specifications.

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Whatever your optical needs—Tracking — Reconnaissance — Plotting — Photo Interpretation — Mapping — the uniformly high quality of GOERZ lenses is your guarantee for reliable performance.
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# letters

## Reviving Reliability

*To the Editor:*

You deserve a "well done" for your excellent editorial, "The Girl with the Soldering Iron" (M/R, Feb. 27). You put some life in the "tired" word "reliability."

Edward W. Locke
Director, Customer Relations
Defense Products Headquarters
Westinghouse Electric Corp.
Washington, D.C.

*To the Editor:*

Thought you might enjoy hearing that we intend to circulate copies—plant-wide—of the editorial "The Girl with the Soldering Iron."

It is a funny coincidence because in the next few weeks I will be shooting a movie here called "One Bad Solder Joint," depicting "Wanda" and her soldering iron, and how important she is to the success of our operation. I had been kicking the idea and the script around for about three months, and finally got the okay on it, so I really got a boot out of seeing the editorial.

Many thanks for the wonderful coverage and attention you gave us in the Guidance System edition.

Taylor Gates Benson
Public Relations Representative
AC Spark Plug Division
General Motors
Milwaukee

## MiniWeld Treatment

*To the Editor:*

We are pleased with the publication of the article on our MiniWeld Erector Set equipment (M/R, Feb. 27, p. 26). The treatment of the text and figures was excellent.

Paul N. James
Reports Section
Francis Associates
Marion, Mass.

## Chrysler's Autocollimator

*To the Editor:*

A great many of us at the Chrysler Corporation Missile Division read with much interest the article on the Twist Autocollimator optical alignment system scheduled to be used on the mobile *Minuteman* ICBM (M/R, Feb. 6, p. 33). However, we were somewhat disappointed that the article did not assign credit for the design and development of this unique system.

The Twist Autocollimator was designed, developed and currently is being produced by the Chrysler Missile Division for the Autonetics Division of North American Aviation, Inc. It is an outgrowth of several years of proprietary development work within our Advanced Development Branch performed under the direction of Dr. J. G. Gievers, one of the foremost authorities in optical alignment.

We are certain that MISSILES AND ROCKETS, and our customer, the Autonetics Division, would welcome this proper assignment of credit.

C. J. Weatherred
Manager, Program Development
Chrysler Corp. Missile Division
Detroit

## Credit for Plating

*To the Editor:*

I should like to set the record straight on some material printed in the Nov. 28, 1960, M/R, in an article entitled "Selective Electroplating Saves Time and Dollars."

In this article, you described a selective plating maintenance operation carried out on a group of missile launching valves on a submarine designed to carry the *Polaris* missile. My firm, Metachemical Associates, Inc., actually did the selective plating job and is thus in a position to correct several inaccuracies.

To begin with, the submarine was the USS Patrick Henry and not the USS George Washington. This is a serious factual error and should have been checked. Second, these valves are not "exposed to a hostile sea water environment" *per se*, as mentioned in the article, but rather to other environmental conditions and variations.

Third, the thickness of the tin-indium specified was not 0.003 in., but varied from a flash plate on threaded areas to a maximum of 0.003 in. on certain sections of the valve . . .

Most important to us—and we believe to your readers—is the fact that full credit in the article was given to the manufacturer of the particular selective plating process, while no credit was given to Metachemical Associates, Inc., who originally surveyed the problem and engineered the solution described. Furthermore, our personnel worked around the clock for more than three weeks so as to complete the job and not delay Navy activities. In fact, our entire staff is proud of a letter of commendation we received for ". . . a job well done under difficult field conditions . . ." from Vice Adm. W. F. Raborn, Director of the *Polaris* Program for the Navy . . .

Herman R. Reade
Metachemical Associates, Inc.
Forest Hills, N. Y.

*That portion of the article containing "inaccuracies" was drawn from a press release approved and cleared by the Navy's Special Projects Office. Mr. Reade's comments have been verified by the Navy and we are pleased to set the record straight. To further assure full credit where due, we must mention that the consultant for the task was Marlane Development Co. of New York, which provided the Dalic Process plating equipment and engineering assistance. And a representative of Sifco Metachemical, Inc., provided technical assistance to Marlane throughout the operation.—Ed.*

**M/R BUSINESS OFFICES**

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**Frankfurt/Main, West Germany—Friedrich-Ebert-Anlage 3**


# —when and where—

## MARCH

**IRE International Convention, Coliseum and Waldorf-Astoria Hotel,** New York City, Mar. 20-23.

**American Society for Metals, 12th Western Metal Congress, Ambassador Hotel and Western Metal Exposition in Pan-Pacific Auditorium,** Los Angeles, Mar. 20-24.

**23rd Annual American Power Conference,** Sherman Hotel, Chicago, Mar. 21-23.

**American Meteorological Society, General Meeting,** Chicago, Mar. 21-23.

**American Chemical Society, 139th National Meeting,** St. Louis, Mar. 21-30.

**Third Annual Symposium on Electron Beam Technology, Alloyd Electronics Corp.,** Boston, Mar. 23-24.

**4th Symposium on Temperature, Its Measurement and Control in Science and Industry, sponsored by ISA, American Institute of Physics, National Bureau of Standards, Veteran's Memorial Hall and Deshler Hilton Hotel,** Columbus, Ohio, Mar. 27-31.

**American Nuclear Society, Nucleonics in Flight Symposium,** Statler Hilton Hotel, Dallas, Mar. 28-29.

**Society of Aerospace Material and Process Engineers, Filament Winding Symposium,** Huntington-Sheraton Hotel, Pasadena, Calif., Mar. 28-30.

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## editorial . . .

# An Open Purse and a Shut Mouth

TENTATIVE STEPS now are being taken toward a large solid-rocket booster program which could serve as a backup to the *Saturn* liquid program. It is an effort which should receive all the financial support necessary to move it forward at optimum speed.

Those closest to the solid propulsion field believe a breakthrough has been made which now can be exploited. A number of firms have been studying and testing the feasibility of concepts in this field since 1959, under both Air Force and National Aeronautics and Space Administration contracts.

These include Aerojet-General, Thiokol, Grand Central Rocket and United Technology. Their approaches were based on work done earlier by these companies and others.

These studies all have pointed to the fact that a big solid booster should be developed, not as a substitute for the large liquid boosters, but as a complement.

Cost of such a program is relatively modest when matched against the possible gains. Best informed estimates are that it can be accomplished for $60-million or less.

A contract between United Technology Corp. and NASA is in the final stages of negotiation. This is for development of a single solid segment weighing 70,000 lbs. This would develop about 250,000 lbs. thrust on the basis of a 60-sec. burning time. This is the first NASA solid contract of any size. UTC is confident enough of success to accept the contract on a shared-cost basis.

This is not entirely altruistic, since there are hopes of a follow-on contract. First segment is scheduled for completion in about three months.

Meanwhile, NASA officials are preparing to lay before the Administration a request for a $15-million supplemental appropriation for a new segmented solid program. This calls for a competition in late spring which would lead to a contract award this summer for segments of up to 110,000 lbs. These would provide a thrust of some 400,000 lbs. on a 60-sec. burning time.

This program could be the big step toward a solid rocket as large as the F-1 liquid engine.

It offers a number of advantages. It would give the U.S. an alternative to *Saturn* in the event of a failure in that important program. It would lay the groundwork for further development of solids.

More important, here is an area of great promise in which it appears we definitely are ahead of the Russians. In the same way the U.S. built its early efforts around the Von Braun team, the Soviet Union leaned heavily on the German scientists it scooped up from Peenemunde and other German centers. Both countries thus concentrated initially on big liquid boosters. But there was a basic difference which often is overlooked.

The Soviet chemical industry is one of the weak spots in the Russian economy. Not only did the Soviets use the German scientists in rocket development, they depended on them for overall help in development of their chemical industry. They thus tied the industry in many ways to a 1945 level of scientific knowledge.

U.S. chemical and propulsion experts, meanwhile, pushed ahead on their own with development of new fields. In these, the Russians were left behind. The broad base of the U.S. chemical industry laid the groundwork for the breakthrough which now has taken place in solids. It should be exploited before the Russians catch up.

THIS LEADS to another important point. As the trade magazine of the missile/space industry, we are devoted to as wide an exchange of technical information as possible. In the long run, the U.S. gains more from this than it loses in making information easily available to the Soviet Union. The situation in regard to solid development, however, calls for a very careful attitude in regard to release of truly detailed technical information.

Technical meetings on solids should be closed to the Russians. Chemical equipment of value in this area should not be exported to them. Papers delivered at open meetings should be carefully scanned for technical security. While this magazine will be the first to complain at unnecessary censorship, we will support fully efforts to play this one as close to the vest as possible.

Exploit the breakthrough; keep our mouths shut. It's a policy that could pay off in the space race.

**William J. Coughlin**

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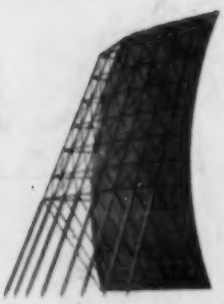

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